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The CHEMICAL AGE

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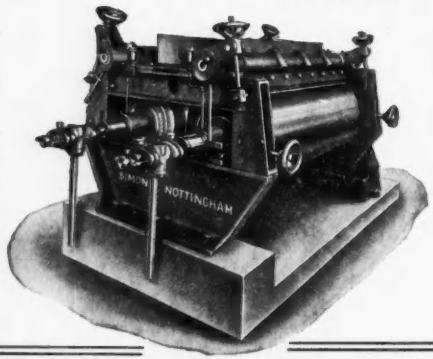

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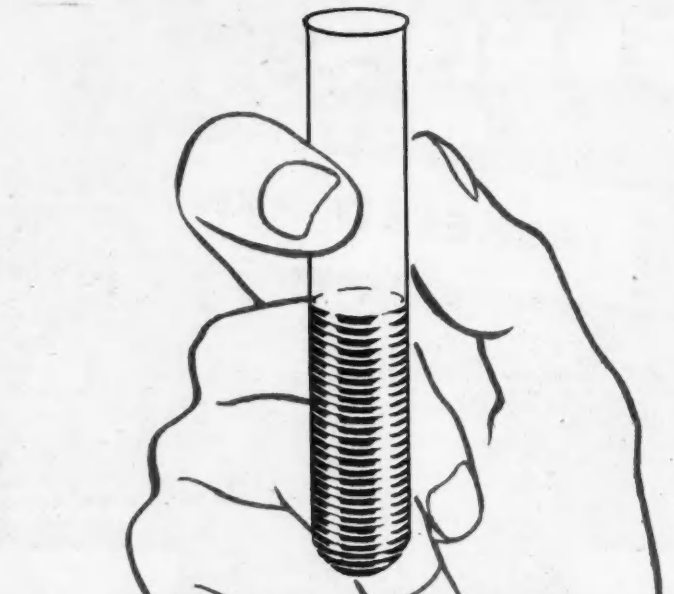

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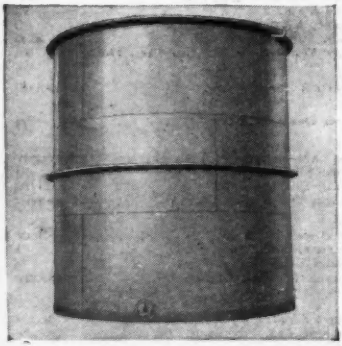

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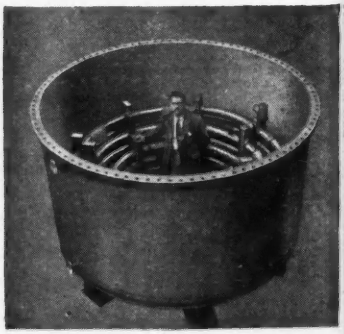

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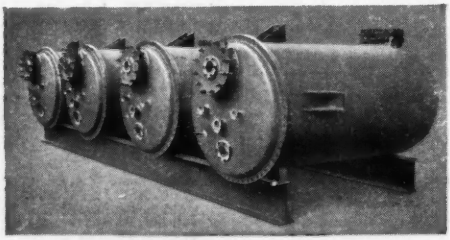

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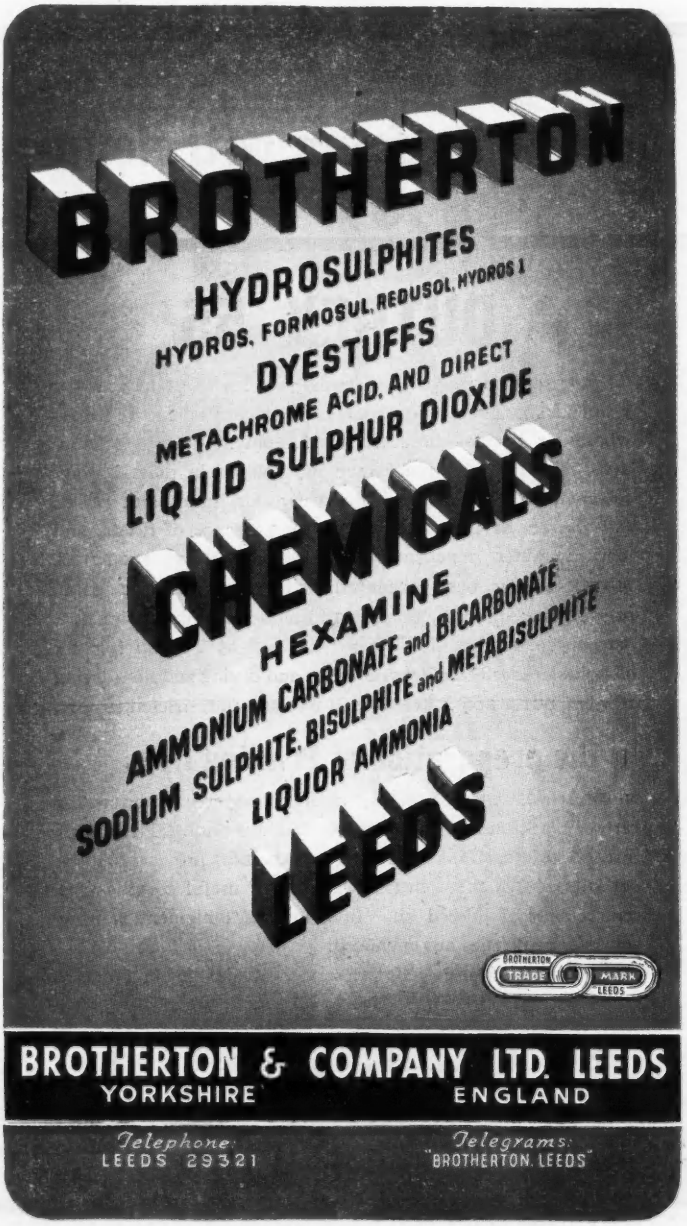
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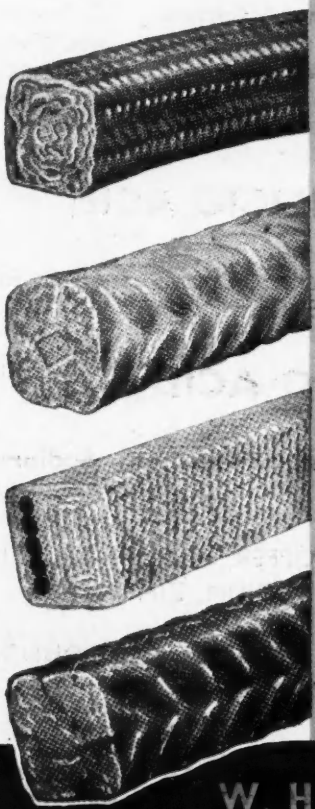

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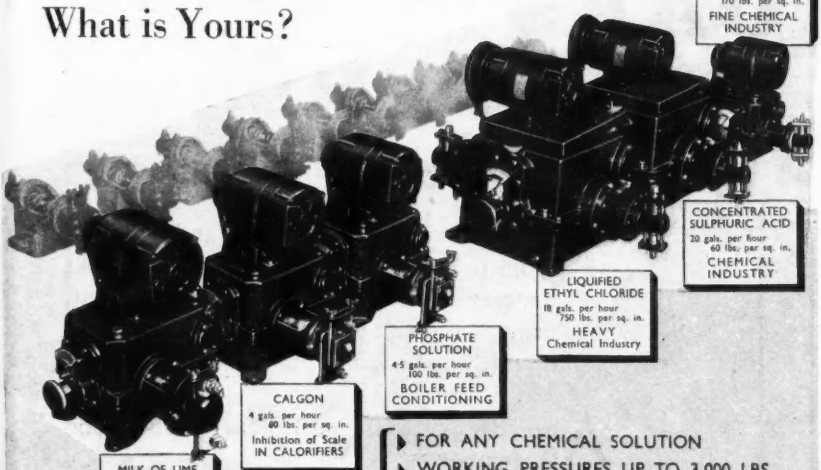

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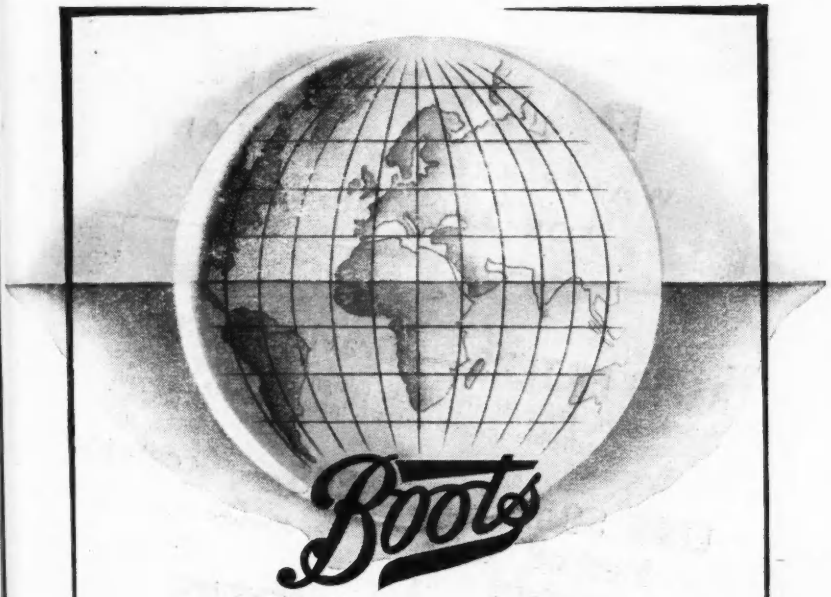

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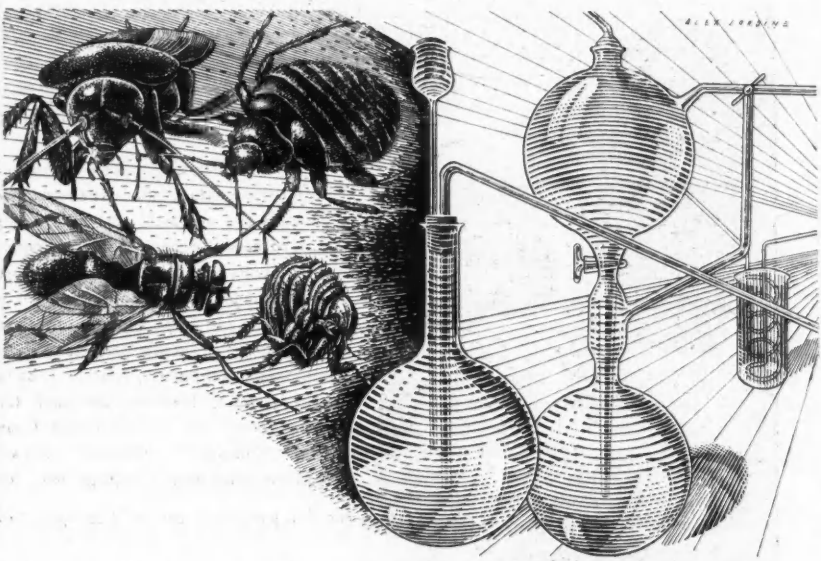

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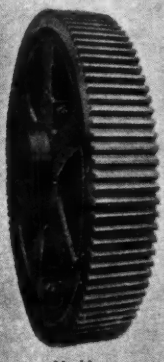

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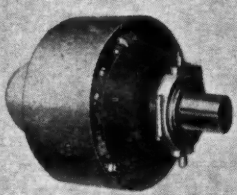

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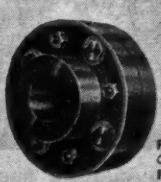

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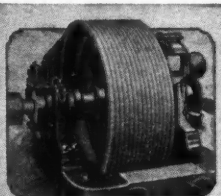

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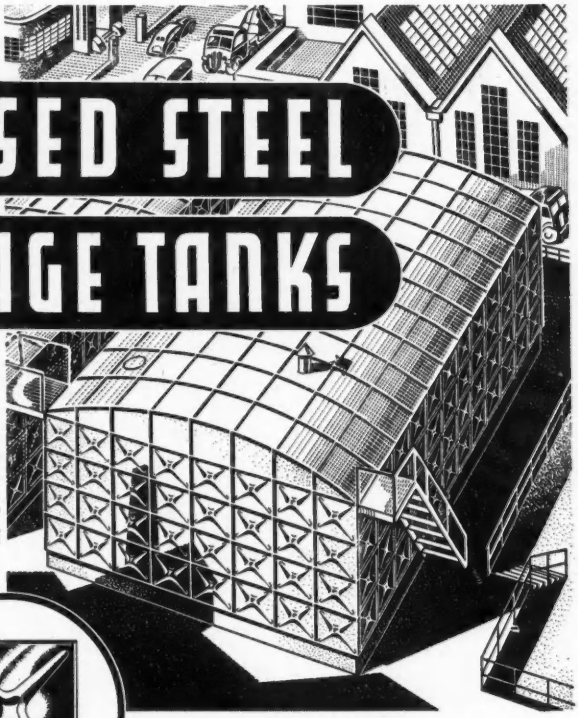

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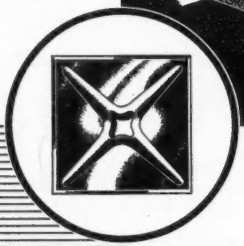

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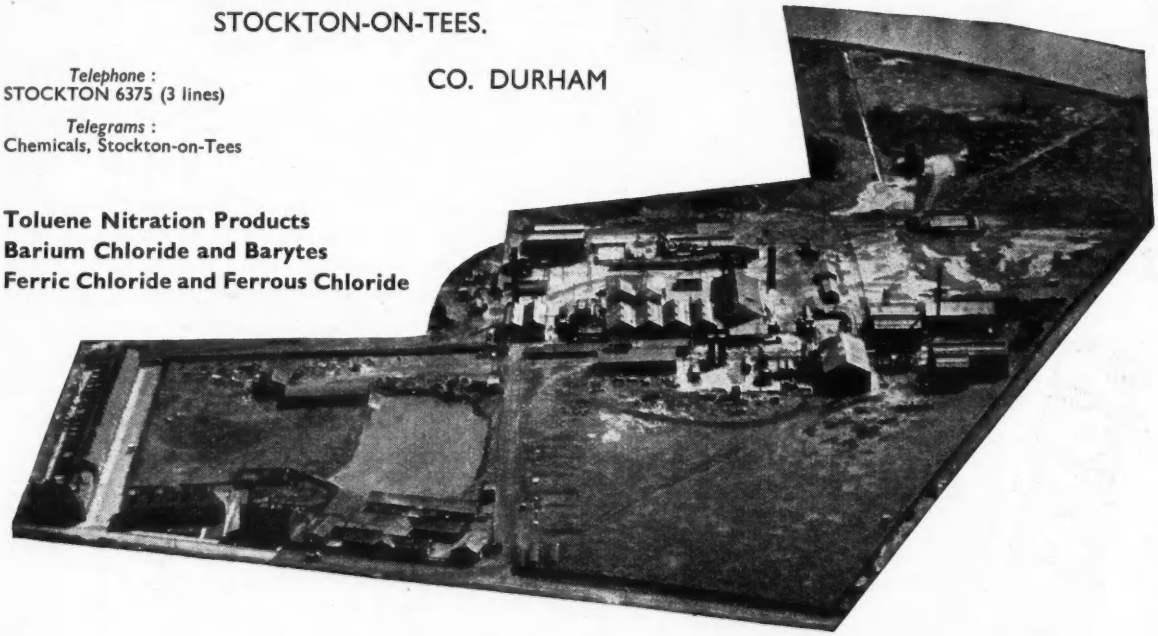

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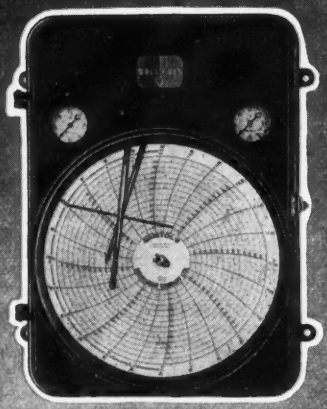

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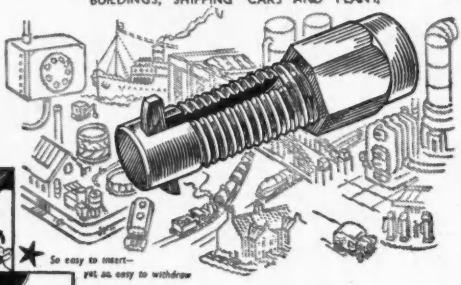

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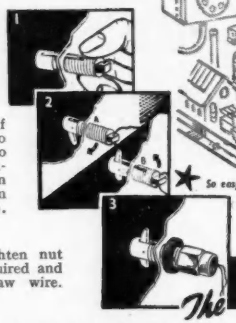

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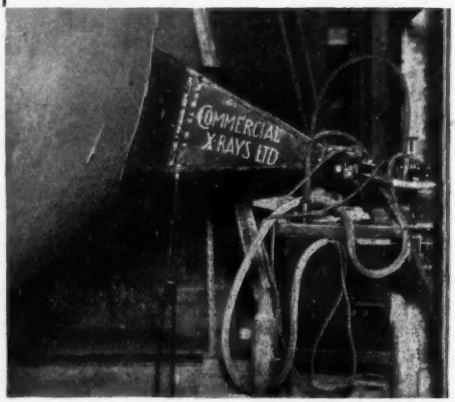

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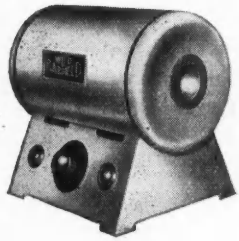

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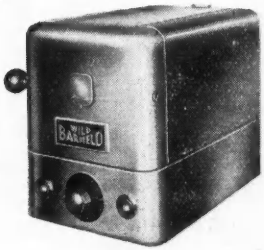

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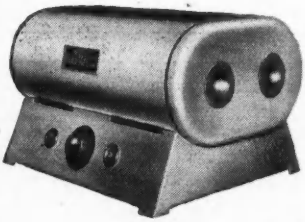

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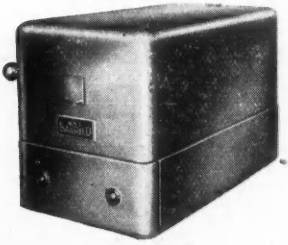

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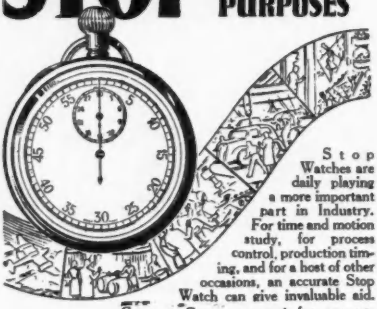

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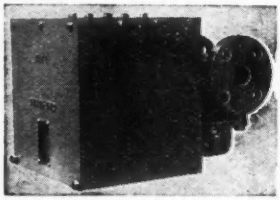

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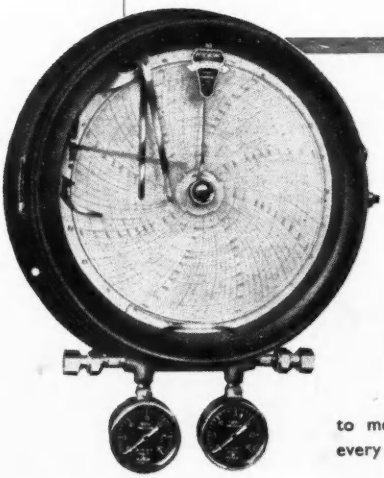

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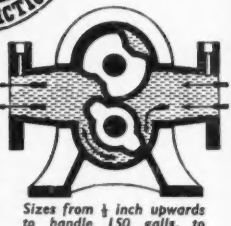

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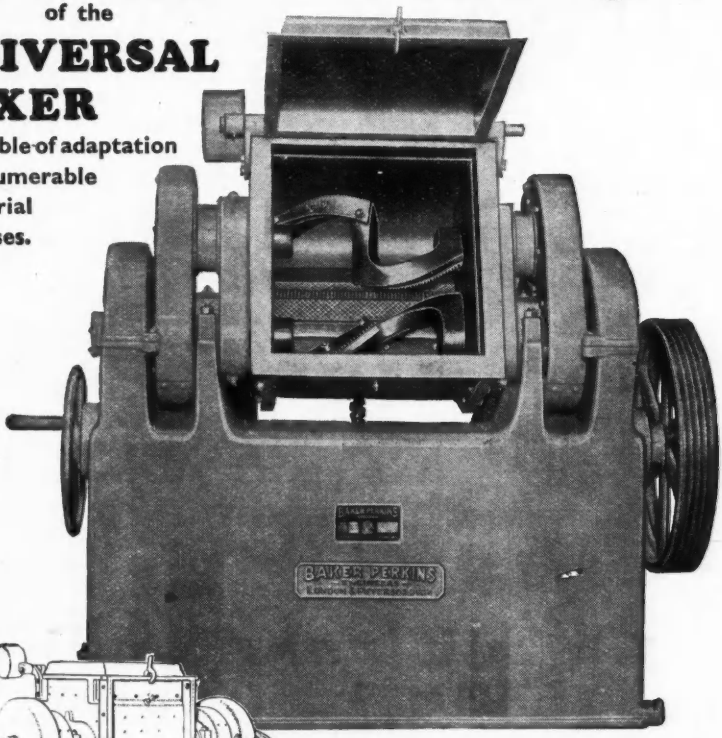

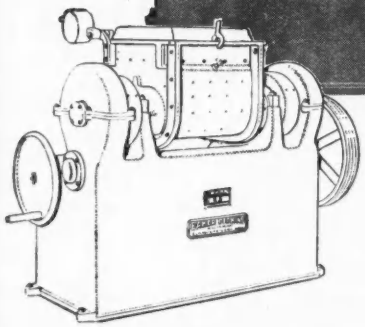

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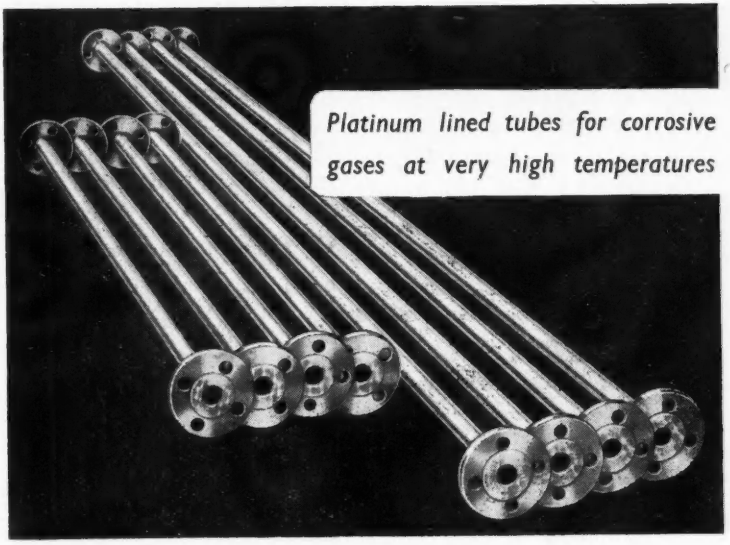

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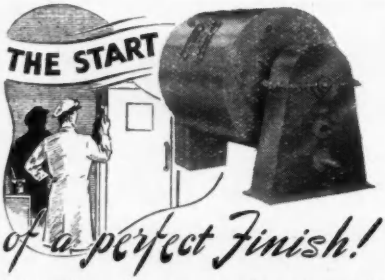

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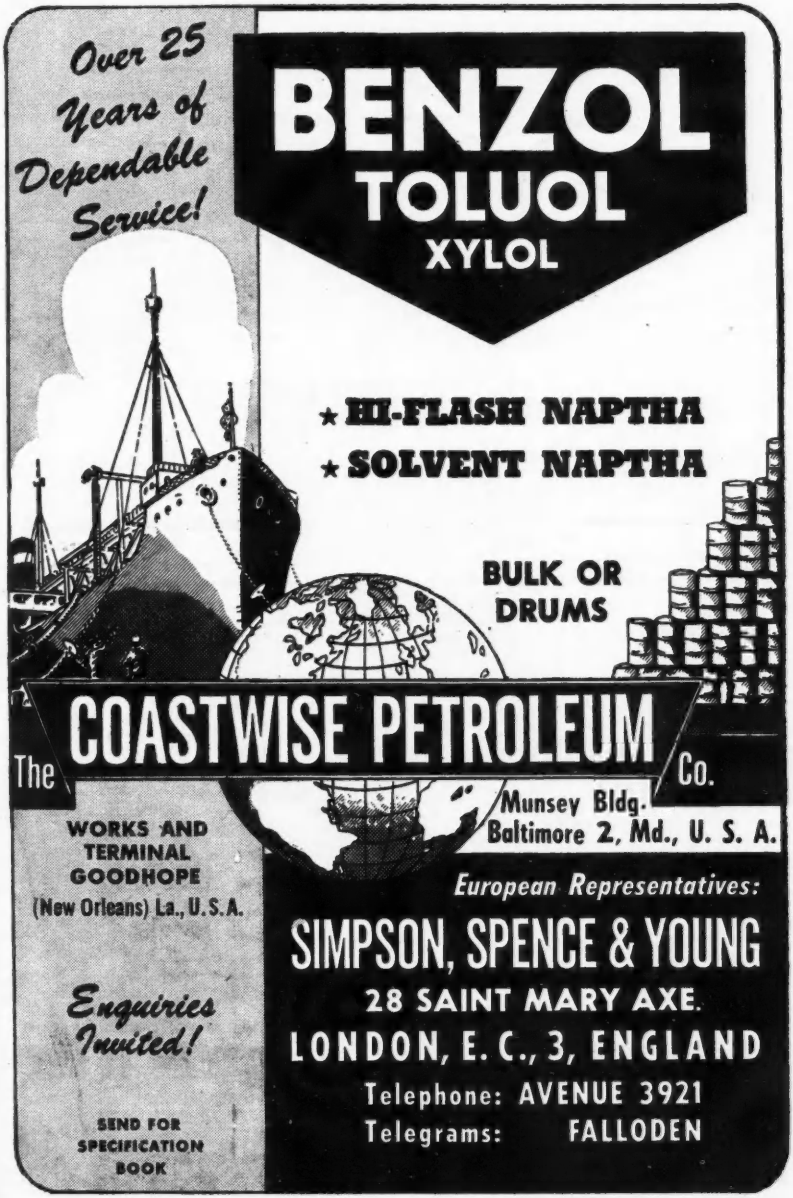
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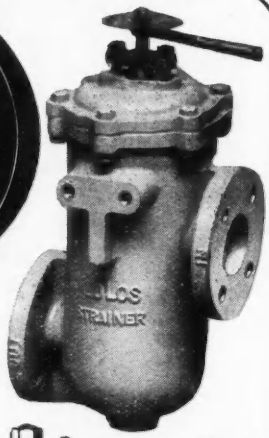

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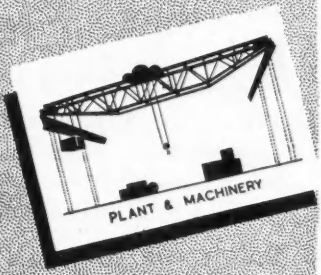

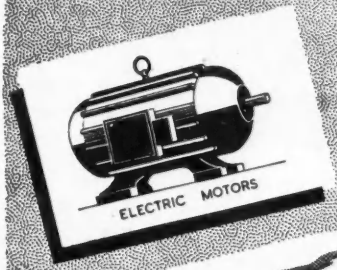

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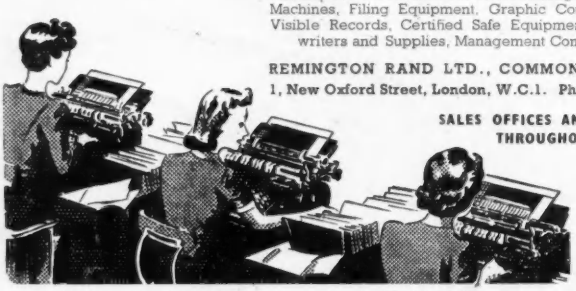

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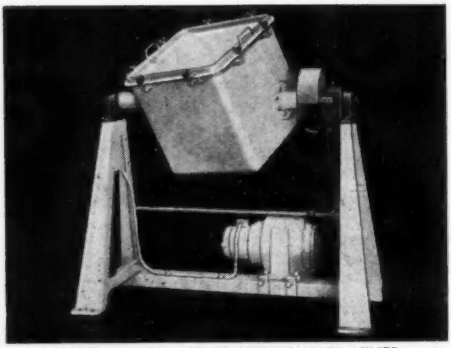

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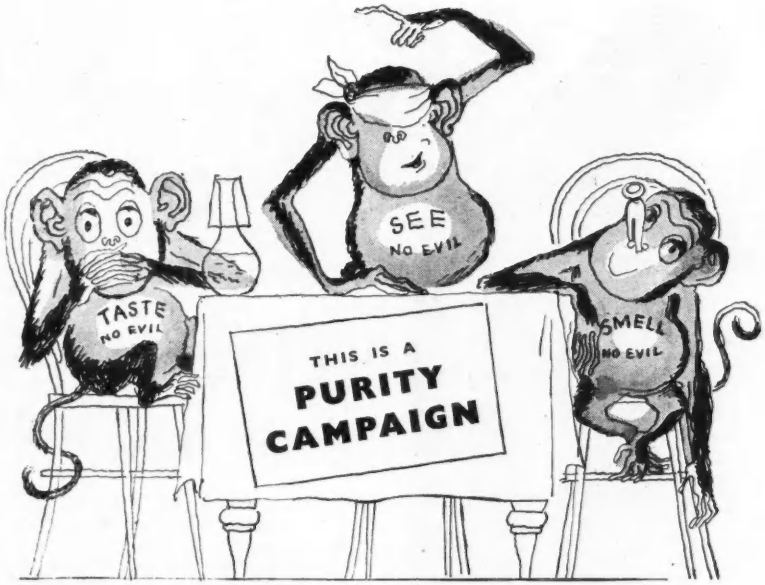

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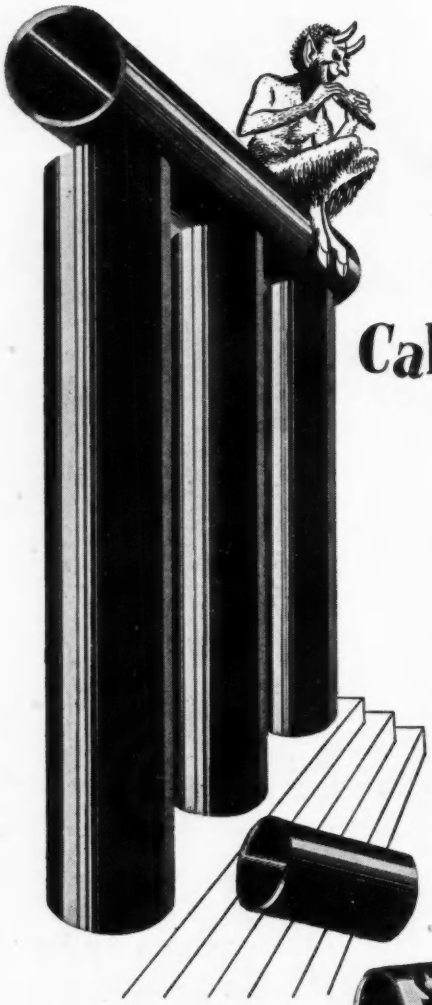

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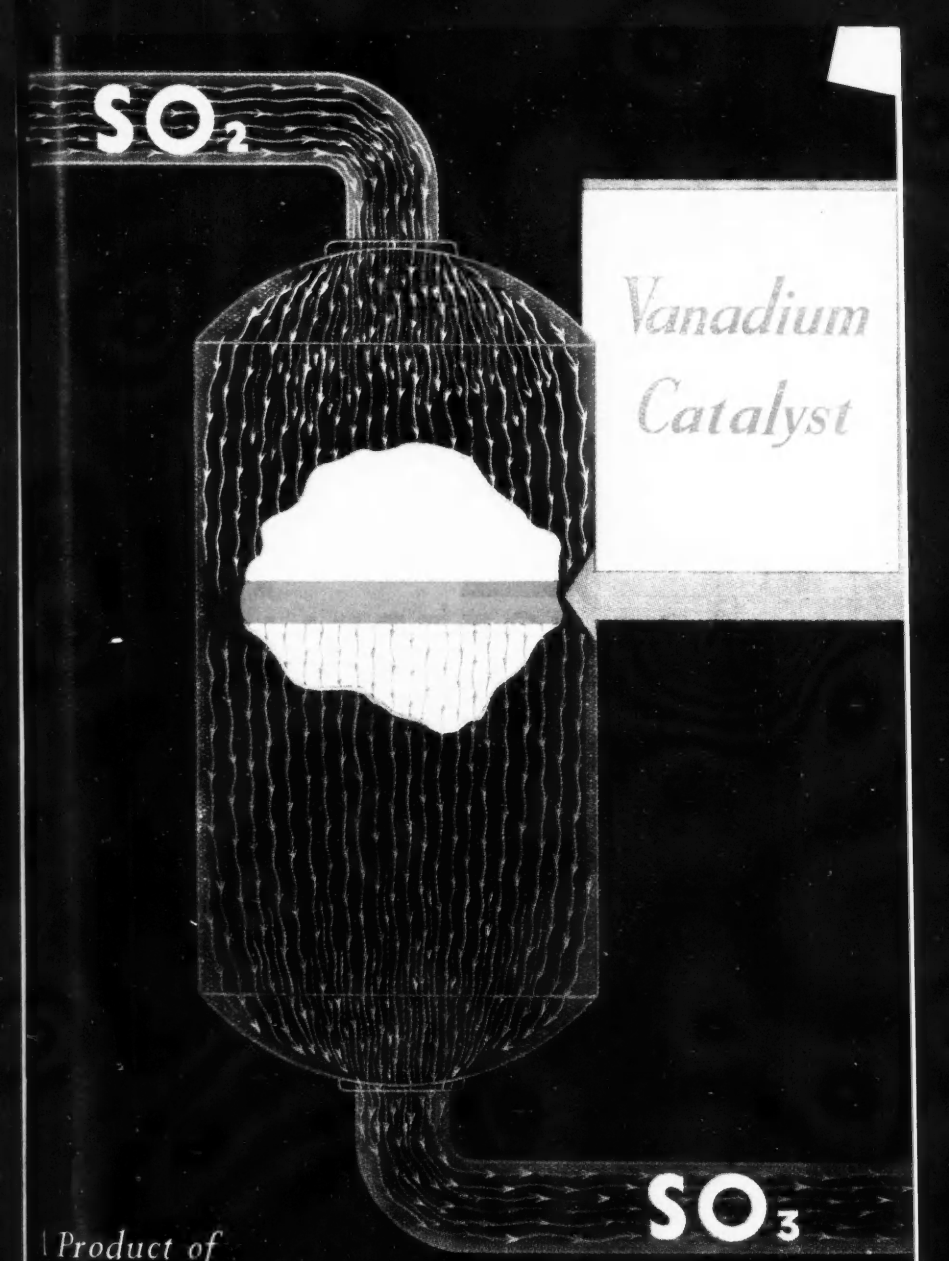

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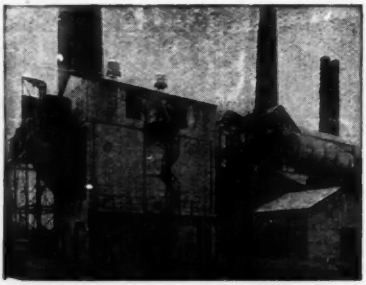

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10 January 1948

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Targets for 1948

THE year 1947 may go down to history as the one in which Britain found herself again after the natural exhaustion caused by the most destructive war in history. Not until 1947, did the country as a whole begin to realise the inevitable results of the unstinted wartime dispersal of the treasure amassed by former generations. Thus was the whole nation reduced in just over 30 years from one of the wealthiest in the world to the verge of bankruptcy.

Our condition was not relieved by the class antagonism fostered by those who should have known better, nor by the Government's insistence in pursuing ideological theories at a time when all efforts should have been directed to staving off the financial crash. This year has seen the nation, and the Government to some extent, brought firmly down to earth. It has witnessed a resurgence of the will to work and there is at least a likelihood that this spirit may enable us to save ourselves.

In this effort, chemistry will have to play a predominant part. It is very easy to call for exports, but much more difficult to achieve the high export target that of necessity is set. Chemicals of all kinds which a year ago were valued at £5.85 million must be raised to £7.5 million a month by the end of 1948. The times when anything that could be delivered would sell are fast passing. Order-books may be filled, but future orders will be harder—much harder—to secure. We shall achieve our target only to the extent that we are able to sell something that the customer wants, of the quality that he needs (and cannot get elsewhere at a reasonable price), or goods, plant or machinery that he cannot make for himself. Preferably we must sell abroad those things that require in their manufacture special skill and knowledge so that the ratio of value of finished product to value of raw materals shall be as high as possible.

Those who direct our export drive are aware of this, though for the time being they are flirting dangerously with the export of our precious raw materials, such as that irreplaceable substance—coal. The chemical industry, based substantially on air, water, coal, lime and salt, can produce goods of the kind that we require to export. The chemist is metaphorically the catelyst; he must devise and control the processes that the engineer puts on the works scale. Fortunately the British chemist has shown himself to be second to none and the chemical industry and allied industries based on chemistry are well fitted to provide one of the spear-heads of the export drive.

There is much that is heartening when we survey the chemical field. There is no lack of effort Schemes to increase the manufacture of known chemicals by improved methods and to undertake the manufacture of chemicals not previously manufactured in this country have never been so abundant. What is lacking is the plant in which to produce these new and important products. Not only in the chemical industry, but in many others engineers and chemists seem

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doomed to make plans which would bring in great returns and to have them frustrated by the shortages of plant and equipment—and have the chagrin of seeing plant they could have used exported to give their foreign competitors the lead.

We hope in 1948 to see the drive for exports tempered by observance of a long-term plan; a few months more tightening of the belt now will bring much larger returns when the new plants get into production.

The A.B.C.M. referred in its annual report to what it termed the "short-sighted policy of exporting chemical plant so badly needed in this country" and added: "Such exports can provide only a temporary and largely non-recurring benefit, as compared with the continuing return which would result from the use of the plant in the U.K., thus giving increased production and exports of chemicals."

A cheering sign is the extent to which home production of chemicals, made possible by refining petroleum in this country, is to be undertaken as soon as the necessary plant can be produced. Announcements have been made during the year of a great new plant to be built by the Shell Company at Thornton-le-Moor and of extensions to the Shell plants at Stanlow and Shellhaven; of the plant being built at Manchester by Manchester Oil Refineries (Petrocarbon, Ltd.); and of the combined Anglo-Iranian—Distillers Company plant. Industrial alcohol, plastics, detergents, wetting agents, acetone, ketones, higher alcohols, and other chemicals will be made available in large quantities as the result of these new ventures.

We have urged repeatedly in these columns in the past that home refining of petroleum should be set up in this country. Now we are happy to see that the oil companies have come unreservedly to the same conclusion. The manufacturers of chemical plant will now presumably have an opportunity of gaining new experience which they will no doubt put to good use. Proposals have also been made lately by the Royal Dutch Shell group to erect a refinery on the Thames and another on the Manchester Ship Canal. Others are contemplated and await Government sanction. This extension to what is fundamentally a branch of the chemical industry is very welcome.

In the expansion of the chemical industry which we can foresee there must also be expansion of educational facilities, and we must find people who can and will take advantage of them. Employers must face the problem of encouraging their employees of all grades to continue to study after they leave school. Employers may have to provide the facilities as well as the incentive. Close liaison between technical colleges and employers is indicated; we want more teachers, more colleges, more teaching facilities.

TODAY AND TOMORROW

By LORD McGOWAN, K.B.E. (Chairman I.C.I., Ltd.)

DESPITE all the obstacles and setbacks of the year that has passed, I remain an optimist concerning the future of this country. At the moment we are struggling through an economic tempest such as this tough and resilient little nation of ours has never known in all its history. We are in a battle—let there be no mistake about that—a battle for output and for a just share in the world's markets, on the outcome of which depends our survival as a first-class Power. Our greatest need at this moment is resolution—the resolve in each and all of us to face the facts and to see things through, as we have always done.

Today, with " VJ " Day more than two years behind us, we are entering a period of still greater austerity . . . . Why are we sending so much overseas? The answer is a matter of simple economics. We are spending, as a nation, more than our income. That is a madness, in man or State, that leads only to the workhouse.

Each individual industry has therefore been set its target, and the chemical industry is called upon for an increase in exports of 17 per cent by the middle of 1948, and 28 per cent by the end of the year. These figures do not, however, present a clear picture of what is demanded of us.

Firstly, the chemical industry must meet essential home needs and the demand for the very much more highly priced indirect export of materials such as textiles made from chemicals. Secondly, some branches of the chemical industry would have to do substantially more to offset others, the demand for whose products for essential home purposes, such as food production, will prevent them from reaching these export targets. Thirdly, it must be remembered that certain chemicals are included among the items which foreign countries insist upon having when concluding trade agreements.

From the White Paper published a few weeks ago, it is perfectly obvious that our country now must " cut its coat according to its cloth " in raw materials, and many expansion schemes must be temporarily suspended.

I conceive it to be the duty of leaders of industry to get at the inner consciousness of their people, so as to underline the issue. Hitherto, capital and labour have sat on different sides of the table. That table must be removed, so that workers may realise themselves to be just as integral a part of any concern as management. In I.C.I. we practise this creed, and it is to be hoped that our methods will find imitators in wider fields. . . .

Production is therefore the vital question. Some day in the future we shall enter a buyer's market, when quality and reputation will mean everything. The loss of the present seller's market need cause us no despair; we have a unique experience of foreign trading, and we have in British industry men of vision and drive.

In conclusion let me say that, with our splendid organisation, which we are improving all the time, our slogan being " divine discontent," the prospects of I.C.I. are excellent indeed.—(*The " I.C.I. Magazine," January.*)

Testing Time

A New Year Message from Mr. J. Davidson Pratt, director of the Association of British Chemical Manufacturers

The British chemical industry enters 1948 *with a lively consciousness that this year will be a testing time for all industries, and that a heavy responsibility devolves upon chemical production as a basic industry upon which so many other national activities depend.*

I am, I think, justified in saying that the chemical industry as a whole can be relied upon to play its part to the fullest extent of the resources it can dispose in hastening the national recovery which we all seek.

NEWS REVIEW OF 1947

JANUARY

FIRST details were announced of the Government project to carry out a census of production of chemicals, dyestuffs and drugs in 1946 as a precursor of a national census of production, then planned to be completed in 1947.

Mr. D. C. Martin, former general secretary of the Chemical Society, was appointed assistant secretary of the Royal Society

Included among Knights Bachelor created in the New Year Honours List were Mr. William Henry Coates, deputy chairman of I.C.I., Ltd.; Prof. Walter N. Haworth, director of the department of chemistry, Birmingham University, and Mr. Ernest Woodhouse Smith, former president of the Institute of Fuel; Sir Frederick Joseph West, chairman of West's Gas Improvement Co., Ltd., received the G.B.E. Mr. J. W. Gibb, director of the Alkali Division, I.C.I. and Mr. L. B. Pfell, research and development manager of the Mond Nickel Co., Ltd., were among the number in chemistry and science who received the O.B.E.

Lt.-Col. Ernest Briggs, C.B.E., D.S.O., retired from the chairmanship of Lever Bros. (Port Sunlight), Ltd., and was succeeded by Mr. G. A. S. Nairn. Mr. F. K. Kielberg resigned the joint managing directorship of the United Molasses Co., Ltd. (remaining chairman) and was replaced by Mr. G. W. Scott.

The Electrodepositors Technical Society celebrated in London its 21st anniversary.

Rising production of most basic chemicals in the U.K. and a corresponding increased demand was revealed by the current *Digest of Statistics*.

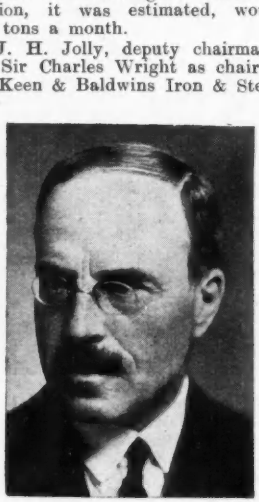
A Government Order revoking existing Control of Sulphur Orders set up a new price schedule showing a general reduction of 25s. per ton.

Chemicals and oils were revealed to have undergone the largest wholesale price increase—5.5 per cent, 67.5 per cent higher than in 1938—in a Board of Trade review of commodity values.

Sir Frederick Bain, M.C., deputy chairman, Association of British Chemical Manufacturers, was nominated to succeed Sir Clive Baillieu as president of the Federation of British Industries. Dr. C. A. Thomas, a vice-president of the Monsanto Chemical Co., became president of the American Chemical Society.

A critical stage was reached in the limitation of industrial activity caused by dwindling supplies of coal. A CHEMICAL AGE staff reporter visiting the Liverpool region reported that at the I.C.I. Alkali Division at Northwich coal stocks were "negligible" and production of soda ash was only 35 per cent of the November figure. Loss of steel production, it was estimated, would be 250,000 tons a month.

Mr. J. H. Jolly, deputy chairman, succeeded Sir Charles Wright as chairman of Guest, Keen & Baldwins Iron & Steel Co., Ltd.



Sir Henry Tizard, who in February was nominated chairman of the council responsible for advising the Government on scientific policy

FEBRUARY

Very marked increases in British chemical exports in 1946 were shown in the annual Trade & Navigation Accounts. Typical increases above the 1945 totals were: copper sulphate 52,161 tons (44,317) soda ash 4,208,852 tons (3,888,325), caustic soda 3,102,425 cwts. (2,987,133).

A new Control of Non-Ferrous Metals Order increased maximum prices of copper (by £19 per ton), lead (by £15), zinc (by £15), zinc oxide (by £12.15).

Mr. M. McDougall replaced Mr. Douglas Campbell as British member of the Combined Tin Committee in Washington.

I.C.I., Ltd., accepted in principle the adoption of a 44-hour week for workers in all its industries.

Drastic increases in the prices of unrefined oils and fats and technical animal fats were announced, including: crude linseed oil by £65 to £200 per ton; crude rapeseed oil by £99 to £190 per ton; crude castor oil by £70 to £180.

The temporary closing of the I.C.I. Metals Division factory at Witton was among the many evidences of arrested production in all parts of the country arising out of the continuous diminution in coal supplies to industry.

Mr. Alec Webster, of the technical staff of the R.N. Propellant Factory, Caerwent, was appointed Safety Officer of the Association of British Chemical Manufacturers. Mr. Ellis Hunter consented to serve a second year as president of the British Iron and Steel Federation.

The first of several recognitions of Sir Robert Robinson's great contributions to chemical knowledge was the award to him in March, of the Franklin Medal, the chief honour of the U.S. Franklin Institute

Mr. Robert Foot, chairman of Powell Duffryn Technical Services, Ltd., formed in March to carry into new fields the development work which the parent group has long performed in the English mining industry

As a result of the heightening shortage of electrical power for industry THE CHEMICAL AGE and other periodicals were asked by the Ministry of Fuel and, agreed, to suspend publication for a fortnight. Interruption of electricity services in 26 counties brought many industries to a standstill.

At a meeting of the Royal Society of Arts a representative meeting agreed to the holding of an international exhibition in London in 1951, commemorating the Great Exhibition a century ago.

The Government decision was announced to establish groundnut plantations on a vast scale in East Africa and Northern Rhodesia, estimated to produce more than 600,000 tons annually four years hence.

The first meeting of the Chemical Society at the Royal Society of Arts in 1841 was commemorated at a joint meeting of the Society and the R.S.A. at which Sir Harold Hartley reviewed the principal events in chemical progress in the century.

The National Sulphuric Acid Association reported that production of acid in the previous year was 1,379,194 tons and total consumption of acid and oleum 1,397,364 tons. Total exports of chemical manufacturers (excluding drugs and dyestuffs was £670,789 less than in February, 1946.

MARCH

The prospect of establishing a widespread and valuable peat industry in Scotland was foreshadowed by the registration in Edinburgh of a company to produce wax and other products from peat on a large scale and by the project for a fully-mechanised peat industry recommended by Mr. Anders Tounter, Norwegian official of the Ministry of Fuel to the Highland Development League.

Messrs. R. H. Heyworth, A. E. J. Simon Thomas and F. J. Temple were appointed

The inauguration of the new president, Mr. H. W. Cremer, was performed at the annual luncheon of the Institution of Chemical Engineers

directors of Lever Brothers and Unilever, N.V. Mr. Glenn S. Watson was appointed chief chemist of the Calco Chemical Division of the American Cyanamid Co. Mr. W. E. Hamer was promoted research superintendent (process investigations) and Dr. J. W. Barrett, research superintendent (exploratory and application research) of Monsanto Chemicals, Ltd.

The formation was announced of the Steel Company of Wales with capital of approximately £50 million to co-ordinate, modernise and develop some of the principal tinplate works in S. Wales.

The Shell Company made known its plans to erect on a 85-acre site at Thornton-le-Moors, Cheshire, at a cost of several million pounds a plant to manufacture acetone and several other chemicals from petroleum.

Mr. J. Macaskill was appointed a director of British Glues and Chemicals, Ltd. Mr. T. C. Belleridge (Cooper, McDougal and Robertson, Ltd.) was elected chairman of the British Disinfectant Manufacturers' Association.

An electronic method of drying penicillin rapidly and without deterioration in large quantities was described by R.C.A. chemists.

The first stage in a U.S. experiment in underground gasification of large coal deposits to produce hydrocarbons was reported by the Alabama Power Co.

The discovery of potash deposits in Saskatchewan—the first in Canada—was reported by the Federal Department of Agriculture to be " of tremendous importance to agriculture " if supplies were sufficiently large.

The formation of the Fertiliser Society for fertiliser manufacturers and distributors was announced, co-ordinating the interests of associated concerns.

Plans for the general adoption of a 44-hour week for chemical workers were ratified as a result of discussions by the Joint Industrial Council.

Substantial increases were announced in the official prices of vegetable oils and aluminium.

Newly elected members of the Royal Society included Dr. G. M. Bennett, Government chemist; Prof. E. J. Conway, Prof. M. G. Evans, Miss Dorothy Crowfoot Hodgkin, Prof. H. A. Krebs, Mr. F. G. Mann, Prof. Fritz Paneth. Dr. A. H. Campbell, general manager of the Fermentation Division of Glaxo Laboratories, Ltd., was appointed an executive director of the company. Mr. N. J. L. Megson was nominated chairman of the Plastics Group of the Society of Chemical Industry.

Chemical manufactures exported were worth £2,419,588 (1946, £3,762,269).

APRIL

The first official post-war visit to the U.K. of a Czechoslovak chemical delegation, representing the National Czechoslovak Chemical Works, was lead by Dr. Martinek, and given a cordial reception by the A.B.C.M. and the British Chemical Plant Manufacturers' Association.

Announced price increases of non-ferrous metals included: lead £90 (+ £20), electrolytic copper £137 (+ £10) and ingot or notch bar virgin aluminium £72 15s. (+ £7 5s.) Increased stringency in world tin supplies was foreshadowed by the statement announcing the second interim world tin allocations.

Sir Edward Plowden, a former chief executive of the Ministry of Aircraft Production was named as the Chief Planning Officer under the Government's industrial reconstruction scheme. Sir John Lennard-Jones succeeded Sir Frank Smith as chairman of the Ministry of Supply Advisory Council on Scientific Research. Retirements from I.C.I., Ltd.: Dr. M. P. Applebey, research director,

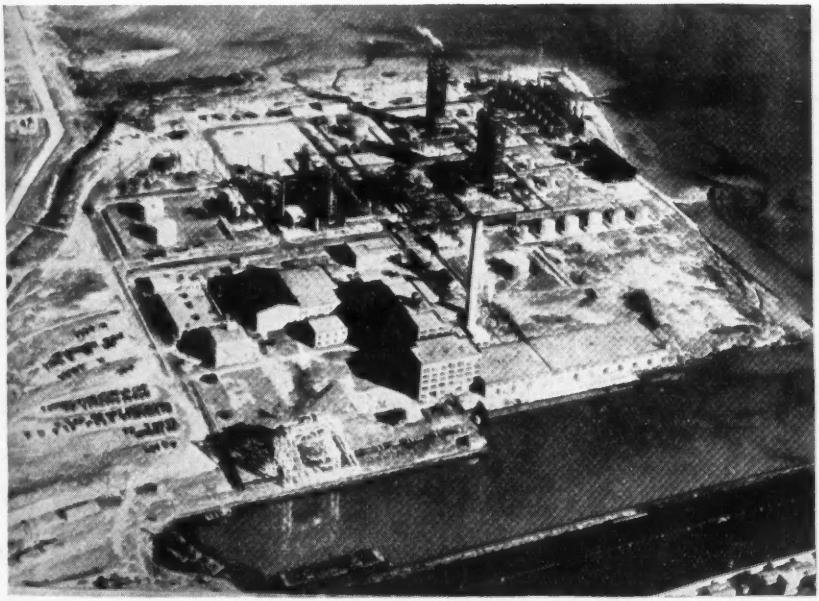
Billingham; Mr. A. E. Bearder, delegate director I.C. (Pharmaceuticals), Ltd.; Mr. H. D. Butchart, in charge of I.C.I. Government contracts; Mr. J. L. Deuchar, chairman, Salt Division; and Mr. J. R. Murray, director, Lime Division.

Mr. W. A. Walmsley (Thomas Ness, Ltd.) was elected president of the Association of Tar Distillers. Membership of the Institution of Chemical Engineers increased by 146 to 1850.

The Government announced there would be no restriction of the use of steel by certain essential industries (electricity generating plant, mining machinery, gas undertakings and coal/oil conversion, etc.). They could use as much steel as they wanted.

A substantial fall in steel production—to a weekly average of 196,000 tons in March (255,700 tons in 1946)—as a result of curtailment of fuel and power was reported by the Iron and Steel Federation. A seven-day week was started in Scottish steel works. Mr. W. M. Dobbie, Socialist M.P. for Rotherham, forecast that a Bill for nationalisation of the iron and steel industry was imminent.

Mr. G. H. Latham was appointed as successor to Sir James Lithgow as chairman of the British Iron and Steel Research Association



Several hundred people lost their lives when the works of the Monsanto Chemical Co. and part of Texas City, U.S.A., were almost demolished by blast and fire which originated in the ignition of ammonium nitrate cargo of the French ship Grand Camp. This aerial photograph showed Monsanto's shattered styrene plant

Sir William J. Larke, director of the British Iron and Steel Federation for 24 years, was the recipient in April of the Bessemer Gold Medal for 1947

The Government Iron & Steel Board approved most of the proposals in the Iron & Steel Federation's £100 million plan for reconstruction of the U.K. steel industry.

Chemical exports during the month realised £2.6 million, against £2.4 million in March.

MAY

Some 90 manufacturers—nearly four times as many as in 1939—contributed to the impressive display of scientific products in the Chemicals & Allied Products section of the B.I.F. in London, the first Fair since the war, at which record overseas orders were secured in London and Castle Bromwich.

Ministry Supply price of tin metal (99 per cent) was increased from £380 10s. to £437 per ton.

The Staveley Coal & Iron Co., Ltd., promised Sheffield University £50,000 over a period of seven years to provide new chemistry research laboratories and facilitate research.

Closer collaboration with chemical industry and the procurement of a site for the erection of new headquarters and research laboratories was notified in the 8th annual report of the Gas Research Board.

Mr. J. Davidson Pratt, director and secretary of the A.B.C.M. was awarded the U.S. Government Medal of Freedom with silver palms for exceptionally meritorious work and co-operation with the U.S.A. as British war-time Controller of Chemical Defence Development. New director of Borax, Ltd., was Mr. Ralph Assheton, M.P. Mr. E. Colbeck, I.C.I., Ltd., metallurgist, was appointed director in charge of research and metallurgy by Hadfields, Ltd.

The completion of 200 years of chemical training and research was celebrated by Glasgow University.

A survey of wages in American chemical industry revealed that rates ranged from the average $1.14 to $1.60 per hour.

Mr. T. M. Willcox and Mr. A. Sharp became directors of the Clayton Analine Co. Prof. E. L. Hirst, University of Manchester, was appointed to fill the newly created Forbes Chair of Organic Chemistry at Edinburgh University. Dr. G. Roche Lynch was elected president of the Royal Institute of Chemistry. Mr. David E. Roe was elected chairman, and Mr. H. C. Worsdall secretary, of the London Section, Oil and Colour Chemists' Association.

A committee of health investigators of the Ministry of Labour declared that reports of mysterious diseases afflicting workers in atomic energy plants "had no great degree of foundation." Supplementary regulations to safeguard workers with radio-active materials were issued by Minister of Labour.

Attendance at the B.I.F. totalled 500,000 (1939, 340,000), including 16,710 foreign buyers.

Additional members appointed to the Ministry of Supply Advisory Council on Scientific Research and Technical Development were Prof. E. K. Rideal and Prof. Wesley Austin.

Sir Robert Robinson, Waynflete Professor of Chemistry at Oxford University was chosen to receive the Albert Medal, highest award of the Royal Society of Arts, "for outstanding to the advancement of organic chemistry." Newly appointed company directors included: Mr. P. J. Fitzgerald (Zinc Corporation, Ltd.) and Mr. W. W. M Hill-Wood (British Celanese).

A series of violent explosions occurred, one barge sank, another and dock buildings caught fire when a sodium compound in the barge *Teal* at Canning Town ignited.

Monsanto Chemical Co., in disagreement with the U.S. Atomic Energy Commission, retired from the atomic energy project at Clinton Laboratories, Oak Ridge, Tenn., in which it had collaborated for two years.

Chemical exports during the month were valued at £2.705 million, £50,000 more than in April.

JUNE

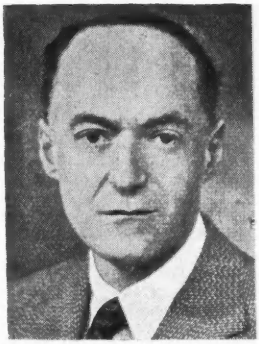
Mr. C. Paine, research manager of I.C.I. Dyestuffs Division was appointed a director of the division. Mr. H. Simpson succeeded Mr. F. H. Gerrard as chairman of Gerrard Bros., Ltd. Mr. Noel G. S. Coppin succeeded Mr. L. W. Codd (who transferred to London) as secretary of the Plastics Division, I.C.I.

Mr. H. J. Jones (Hemingway & Co., Ltd), became chairman of the Association of British Insecticide Manufacturers.

The published text of the Industrial Organisation Bill conferred authority on six Ministries, the Admiralty and the Secretary of State to form development councils for industries and to demand essential information.

Commenting on the start of the five-day week in the mines, the Ministry of Fuel declined to give production figures because the first five-day week was deranged by the strike of enginemen in Durham and by holidays.

Appointments announced: Mr. R. M. Winter, M.Sc., as research controller of I.C.I., Ltd.; Mr. John Gibson Muir as secretary of Lever Bros., Port Sunlight, Ltd., succeeding Mr. A. Watson, elected a director; Dr. J. S. Anderson as senior principal research officer, Atomic Energy Research Establishment, Berkshire; Lt.-Col. W. T. Gibbs as chairman and managing director of British Emulsifiers, Ltd., succeeding Mr. G. S. James; Dr. W. J. Hickinbottom, of Birmingham University, as reader in organic chemistry at Queen Mary College, London.



Prof. C. N. Hinshelwood, president of the Chemical Society, whose centenary address reviewing the Society's activities was a comprehensive study of a century's chemical achievements

The Minister of Education (right) was among those who gained a new insight into the phenomenal development of contemporary chemistry at the exhibition held in association with the celebration in London in July of the centennial anniversary of the Chemical Society

Knighthoods were conferred in the Birthday Honours List on Dr. Andrew M'Cance (Colvilles, Ltd.), Mr. Audrew Macharg (McClelland, Kerr & Co.). Awarded the C.B.E.: Mr. J. E. C. Bailey (Baird & Tatlock, Ltd.); O.B.E.: Mr. H. Halliday (National Federation of Clay Industries); M.B.E.: Messrs. R. S. Brown (Ryland Bros., Ltd.); M. W. Burt (Society of British Gas Industries), Dr. E. H. T. Hoblyn (British Chemical Plant Manufacturers' Association), Miss H. M. McKenzie (Alex. Pirie & Sons, Ltd.); D. Nye (White's Cement Works). Sir Harry Harrison Burn (I.C.I., Ltd., Calcutta) received the K.B.E. Dr. K. B. Wilson and Mr. C. J. H. Tasker of the research department I.C.I. Dyestuffs Division were awarded the Moulton Medal of the Institution of Chemical Engineers.

Representatives from many nations attended the symposium on "Newer Derivatives of Coal and Petroleum" at St. Andrew's University, Dundee, at which important original matter was discussed by chemists and technologists of world renown.

The Fulmer Research Institute was opened by Sir Stafford Cripps at Stoke Poges, Bucks.

Two simultaneous events of world-wide scientific interest, the IX International Congress of Pure and Applied Chemistry and the centenary of the Chemical Society, brought to London one of the largest and most representative international gatherings of scientists for some decades. Among many distinguished guests of the Chemical Society were the Prime Minister, the Minister of Education, Sir Robert Robinson, Sir Edward Appleton, and Prof. Pauling. Important work on definitions was undertaken by the International Union of Chemistry over a period of a fortnight.

Research director of I.C.I., Sir Wallace Akers, writing in the *I.C.I. Magazine*, said it seemed likely that a full-scale atomic power plant would be working in America by 1949.

AUGUST

A small-scale repetition of the Texas disaster occurred at Brest, where a cargo of nitrate of ammonia in a Norwegian vessel entering the harbour caught fire and exploded with great violence. Many casualties were reported.

New York Fire Commission ordered two ships laden with ammonium nitrate to leave New York harbour in view of the dangerous potentialities of the cargo. Shortly before, an explosion in Melbourne harbour of sodium nitrate had caused ten deaths.

Mr. J. Wilmot (then Minister of Supply) announced that the site for Britain's main atomic energy plant would be at Sellafield in the Lake District, and that the atomic pile at Harwell, Berks, would be in operation before the end of the year. The Government Select Committee on Estimates published a report in which it expressed the opinion that the Harwell atomic energy project had been unreasonably delayed, and recommended the holding of an immediate inquiry.

Lord Melchett, deputy chairman of I.C.I., resigned from the board for reasons of ill-health.

It was announced that a new fatless, coupon-free soap would shortly become generally available.

The atomic energy establishment at Harwell announced that the atomic pile had commenced to operate.

The "Enterprise Scotland" Exhibition opened at Edinburgh.

H.R.H. Princess Elizabeth accepted an invitation to become president of the Royal Society of Arts.

SEPTEMBER

The "Staggered Hours" Order was made by the Minister of Labour in order to spread the electricity load.

Sir Stafford Cripps announced the Government export plans at a special meeting at the Central Hall, Westminster. He set a chemicals target of £7,500,000 monthly.

Workers from St. Rollox chemical works celebrated the 150th anniversary of its foundation.

Provisions of the amended Control of Engagement Order conferred upon the Government unparalleled peacetime power to direct unemployed individuals to industry. Qualified chemists were among those not subject to direction.

The American Chemical Society held its 112th national meeting in New York. Attended by 11,000 chemists and chemical engineers, it was the largest meeting in the history of the society. The principal British representative was Dr. L. H. Lampitt.

OCTOBER

Increases in the maximum prices of fertilisers were announced by the Board of Trade.

British and U.S. commanders-in-chief in Germany announced that 682 industrial plants in their zones were to be made available as reparations. Forty-two of these were related to chemical manufacture.

British Industrial Solvents, Ltd., announced a £2 million expansion scheme to provide additional plant for the manufacture of solvents, plasticisers and acetic acid at its Hull works. Also announced was the formation of a subsidiary company to carry out research and development work on penicillin and streptomycin.

NOVEMBER

Mr. G. R. Strauss, Minister of Supply, officially opened the new chemical laboratory of the Royal Aircraft Establishment at Farnborough.

The Ministry of Fuel and Power authorised gas undertakings to raise the price of gas, consequent upon the increase of coal prices.

The 1947 Nobel prizes for chemistry and physics were awarded to Sir Robert Robertson and Sir Edward Appleton. This was the first time in the history of the foundation that both prizes had been awarded to English scientists.

An explosion at the rocket experimental station, Westcott, Bucks, caused the death of three research workers, including Dr. J. Schmidt, a leading German scientist.

Prof. C. N. Hinshelwood and Dr. F. M. Burnet were awarded Royal Medals by H.M. The King upon the recommendation of the Council of the Royal Society.

The Royal Dutch Shell Group announced that two complete refineries were to be built in Britain—one on the Thames and the other adjoining the Manchester Ship Canal.

The Pharmaceutical Society of Great Britain established a precedent at mid-Summer by appointing as their president Mrs. Jean Kennedy Irvine, the first woman to have held office

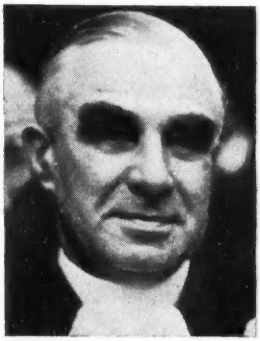
DECEMBER

A reduction of capital expenditure during 1948 was announced in a Government White Paper. It planned to reduce estimated expenditure (£1600 million) by £180 million and required the deferment of the majority of large-scale plans for industrial development.

E. I. Du Pont de Nemours, Inc., Wilmington, Delaware, were accused by the U.S. Department of Justice of conspiring to monopolise the cellulose sheet industry. Among overseas concerns alleged to have been associated with the agreements were British Cellophane, Ltd., and the Viscose Development Corporation.

A British Government spokesman stated that as a result of a tanker shortage and because U.S. consumption of oil had risen by 70 per cent, it had been decided to discontinue plans for conversion from coal to oil burning.

Dr. L. H. Lampitt, who in August was elected president for a second year of the Society of Chemical Industry



Sir Federick Wells, managing director of Sanitas, Ltd., on whom the City of London conferred its highest office, as Lord Mayor for 1947-48

Some Developments in the Heavy Chemical Industry

by A. I. COLEMAN, B.Sc., F.R.I.C., A.M.I.Chem.E., A.M.Inst.F.

THE year 1947, it will be generally agreed, has not been easy. We shall remember for many years the Fuel Crisis, during which the heavy chemical industry in common with other industries, received a bare 50 per cent of the normal fuel allocations. We shall remember the painful months of partial recovery which have followed; the continued struggles with industrial controls; the shortages of materials, in particular those of stainless and other steels.

Control

Fresh in our memories—one might say painfully clear in our memories—are Ministry rulings regarding the application of the Control of Engagement Order to the heavy chemical industry, and the recently issued White Paper concerning cuts in capital expenditure for 1948. In the matter of the allocation of labour, the coal, iron, oil-shale, clay, textile and agricultural industries, etc., receive first preference. In connection with this, we remember the words of the Prime Minister when proposing the toast at the centenary dinner of the Chemical Society; he remarked that the chemists' contribution to national life is to-day the cornerstone of the economic structure of every civilised country.

We all heartily endorse the view of the Prime Minister, but we feel naturally enough, that the "cornerstone" is not inanimate; it is a vital creative force affecting our lives and national prosperity, and as such it would function more successfully were it subject to fewer controls.

At the centenary celebrations of the Chemical Society the brilliant cosmopolitan gatherings paid homage to British chemical industry. At the British Industries Fair the creative efforts of chemical and equipment manufacturers were on view to the world. At both functions it was apparent that our native genius is as strong and as versatile as ever.

The close of 1947 found most equipment manufacturers with the longest order books on record, and the story which those books could unfold would be a strong indication of the "shape of things to come" in the heavy chemical industry. Certain developments, however, have been foreshadowed in the technical press; others are apparent in the latest equipment being installed in new plants. It therefore behoves us to pause to consider some of these developments. Some are the culmination of years of practical experience; others are of startlingly wide application; still others are the first practical employment of ideas conceived and investigated under the difficult conditions prevailing in wartime, and which therefore have only recently emerged after trials in laboratories and semi-scale plant.

Gas-Solid Reactions

When the Standard Oil Development Company of New Jersey put to work a process for the refining of petroleum—in which the catalyst is fluidised, and therefore capable of continuous removal from the reaction system for the purpose of continuous regeneration—the company started rolling a snowball which already has influenced many other gas-solid processes, and which will undoubtedly influence many more.

Dr. J. G. King, director of the Gas Research Board, has reviewed some of the ways in which "fluid" technique could benefit the gas industry.[1] He has pointed out that the method represents a means of handling powdered solids in bulk which is new to the industry, in that it provides a means of maintaining the powder in a fluid, free-flowing condition capable of being fed to, and being withdrawn continuously from, reaction systems.

Plants operating on this principle in the oil industry have reaction chambers 50 ft. high and 25 ft. in diameter, which contain fluidised beds of catalyst up to 300 tons in weight; furthermore, solids are fed to, and withdrawn from, these chambers continuously at rates up to 50 tons per minute.

By contrast, J. A. Lee has applied the fluid technique to the catalytic conversion of naphthalene to phthalic anhydride in a vessel 30 in. in diameter and 5 ft. high, and a throughput rate of 400 lb. of naphthalene per hour was achieved.

Former Difficulties

From the comparison we may deduce that contact, or catalytic, efficiency is substantially independent of plant size. We recollect the method first employed to obtain "good" contact efficiency in a process involving the catalytic reduction of organic sulphur compounds in coal-gas. In this process contact was achieved by splitting the gas stream so that it passed in parallel through large numbers of 4 in. diameter pipes containing earthenware "cups" of catalyst material.

One can imagine the type of plant involved to treat several millions of cubic feet of gas per day, and the difficulties attending the maintenance of a steady temperature of 420° C. throughout the complicated catalyst system. What troubles and trials must have been experienced in charging and discharging the catalyst tubes; the "hot-spots" and distribution problems which developed when carbonaceous matter deposited and blocked the catalyst tubes, and was then burnt off during the regeneration cycle; the precautions necessary to prevent explosion in changing from regeneration to catalyst cycles, and *vice versa*.

The fluid catalyst system appears to offer a completely satisfactory answer to all these problems, and others as well. Like so many answers to apparently very difficult problems, the solution appears to be simple—*i.e.*, keep the solids moving by the gases in which they operate. Fluidising simply comprises the passage of a gas up through a bed of solids at a controlled rate, so that, in effect, each particle is surrounded by gas. Under true fluidising conditions, the whole bed becomes a mobile fluid, visually taking on the appearance of a boiling liquid. There is a sharp line of demarcation between the dense phase of the fluidised bed, and the freeboard zone above the bed. Furthermore, by maintaining the solids in the fluid state, they can be fed, transported, discharged, and controlled by instruments just as if a liquid were being processed.

Clearly the new fluid technique could not be just a useful aid in the catalytic field alone. The fluid bed provides excellent contact conditions, whether the purpose for which good contact is required is catalysis, or the transfer of heat, or mass, or any combination of the three.

New Applications

Therefore it is logical that we should now hear of the possible application of the "fluidising" principle to the Fischer-Tropsch synthesis; to the production of water gas, producer gas and the continuous carbonisation of coal; the purification of crude coal gas by "iron-oxide"; the roasting of ores and ore concentrates; the production of lime from naturally-occurring carbonates; the re-burning of dried waste calcium carbonate sludges; the activation of carbon;[2] the catalytic oxidation of ammonia;[3] and in fact to very many processes involving chemical or physical changes in gas-solid systems.

"Fluidisation" would appear to be a new addition to the list of unit operations. This does not imply that fluidising is a new invention. It has long been employed commercially in such widely differing devices as the Fuller-Kinyon pump, and the Winkler gas generator. But it is only recently that the principles and art of fluidised gas-solid processes have been clearly described and applied in practice.

Kalbach[4] has summarised the advantages of fluidisation thus:—

"1. Excellent temperature control—the body of solids serves as a thermal flywheel.

2. Excellent temperature uniformity—rapid mixing and frequent contact of the particles eliminate hot spots.

3. High reaction rates—small particles mean increased surface for reaction.

4. A method is provided for moving large quantities of solids at low cost.

5. A deep bed can be maintained at reaction conditions."

The advantages have been described; what are the limitations? The most important is that fluidised conditions cannot be maintained when the solids feed is of too high a moisture content, or when softening, or fusion, or any surface adhesion of the particles within the bed takes place. These condition will lead to the formation of agglomerates which cannot be kept in suspension at the prevailing gas velocity, and which will therefore sink to the bottom of the bed.

It is clear that in certain situations, *e.g.*, when the solids may pass through a plastic stage during reaction, the whole bed could become static, and the reactor choked. However, thermodynamical forethought will, in most cases, reveal the danger, and provisions can be made accordingly.

Also, it is clear that in hot processes, the waste gases from the reactors can be used for pre-drying wet feed materials, in auxiliary, conventional, drying equipment. Thermal economy is an additional advantage claimed for fluidised processes.

Ash and Particle Problems

The next limitation concerns fuel injection for hot processes. If oil is used, the ash it contains will not appreciably contaminate the material being processed. If powdered fuel is injected, the ash content will contaminate the product according to the fuel ratio. If we take a hypothetical case of a process requiring 0.3 ton of pulverised coal per ton of product, it follows that at 5 per cent ash in coal the product will contain 1.5 per cent of coal ash. However, against this must be balanced the excellent conditions obtained for combustion, it is reported that perfect combustion of oil has been obtained with fractions on 1 per cent of oxygen in the exit gases. Naturally, the objections which accrue to the use of solid and liquid fuels do not apply when fuel gases are employed.

A further partial limitation can be foreseen in the relationships which exist between

operating rates, particle sizes and dust loadings. The amount of reaction obtained is frequently found to be directly proportional to the gas velocity employed. But the velocity employed is that which will result in the lowest convenient dust loading; coarse particles will fluidise nicely at gas velocities which will blow fine dusts out of the reactor.

Answers to these difficulties are being worked out. Thus, dusts can be trapped in cyclones and returned to the reaction system.

In summarising these advantages and limitations of the " fluid " technique for gas-solid processes, it becomes clear that it is a development of the greatest importance to the heavy chemical industry. We are apparently entering a new era of gas-solid technology. However, it is also clear that in this, as in other developments, much patient work with pilot plants must precede full-scale application. Each new case must be investigated separately, and it will be necessary for chemical and equipment manufacturers to collaborate and co-operate to the full in order to secure the optimum benefits offered by this interesting new technique.

Synthetic Resins

The principles governing the de-ionisation of aqueous solutions by means of cation and anion resin exchangers have been known for many years. Credit for the first exact elucidation of manufacturing techniques, and applications of the resins for specific industrial purposes, goes largely to Adams and Holmes, whose patents and publications appeared in 1935.

British industry was quick to respond; chemists and chemical engineers realised the importance of the new tool, and further industrial research and applications were carried out in Great Britain, notably by the Permutit Co., and in America; it is in these countries that the resins have found the greatest diversity of applications at the present time.

Ion-exchange has been defined as the reversible interchange of ions between a liquid and a solid, involving no appreciable change in the structure of the solid. The definition would appear to warrant the addition of ion-exchange to the list of unit processes. In consequence, the present position with regard to the new technique will be briefly reviewed.

In the field of water treatment the equipment comprises pairs of cells containing beds of the selected anionic and cationic resin granules supported on grids, or beds of anthrafilt. The water is passed through the beds in series, cations being first removed, and then anions. After a time the exchange capacity of the resins begins to decrease; the flow of water is diverted to a freshly-regenerated pair of cells, and the exhausted resins are backflushed by water to loosen the resin bed, and to remove precipitated solids, etc.; then the resins are regenerated by means of the passage of a cheap acid solution through the cation resin bed, and a cheap alkali solution for the anion resin. Sulphuric acid and soda ash are the usual alkalis chosen, and the regenerant solutions are made up to strengths generally not more than 5 per cent by weight. Following regeneration, the spent regenerants are washed out of the beds, and the resins are then ready for a new di-ionisation cycle.

The cycle of operations is clearly very simple; in principle it differs little from the familiar practice of regenerating zeolites with salt solution, and as such it is clearly capable of exact, continuous and automatic control. The de-ionisation and regeneration processes are marked by quite sharp changes in the *p*H and conductivity values of the cell effluents, which changes are capable of interpretation by, and transmission from, electrode elements, to electrical relays, and thence to motorised valves.

In the beet sugar industry, commercial units for the treatment of up to 2000 tons of beet per day are under construction in America. Pilot plant installations have demonstrated that the method enables 10 per cent more sugar to be recovered from the diffusion juices, and that molasses can be converted to edible syrups.

Other specific applications recently listed are: the removal of formic acid from formaldehyde solutions; the artificial ageing of whisky; the recovery of acids, alkalis, and metals from dilute solutions; various applications in the preparation of fine chemicals; the separation and isolation of heretofore unseparable amino-acids; the purification and treatment of fruit juices; the reduction of calcium content of milk for infant feeding; acid removal from dextrose and ethylene glycol; and the processing of sorbitol.

Substantial Costs

The advantages are obvious; we have heard little about the limitations. Perhaps the chief of these lies in the high cost of the resins themselves, and the high cost of regenerating chemicals. The high first cost of the resins is not of great importance, provided their period of useful life is sufficiently long. Present indications are that replacement of the resins at the rate of one-sixth per annum can be confidently anticipated.

The resins themselves need to be produced under extremely carefully controlled conditions. Slight variations of process conditions in the course of manufacture can have a considerable effect on resin performance. The importance of controlled resin manufacturing conditions is of particular interest to commercial users who require, for example, water having a specific resistance of 500,000 ohms, corresponding to a calcium carbonate content of 1.5 parts per million.

In this country, progress has been, and to some extent still is being, restricted by the small quantities of resins available. Moreover, such resins as have been obtainable were insufficiently specific. The possibility of varying resin properties by varying the synthesising procedure is an important point to bear in mind. Much research along these lines is being carried out.

A further complication arises when, by cation-exchange, it is desired to remove calcium from solutions. Regeneration with sulphuric acid may cause the formation of insoluble calcium sulphate, which can screen the resin surfaces. In this eventuality a preliminary regeneration with sodium chloride solution is necessary, to yield soluble calcium chloride which can be washed away. However, the sodium ions exchanged must then be removed by the standard sulphuric acid regeneration procedure.

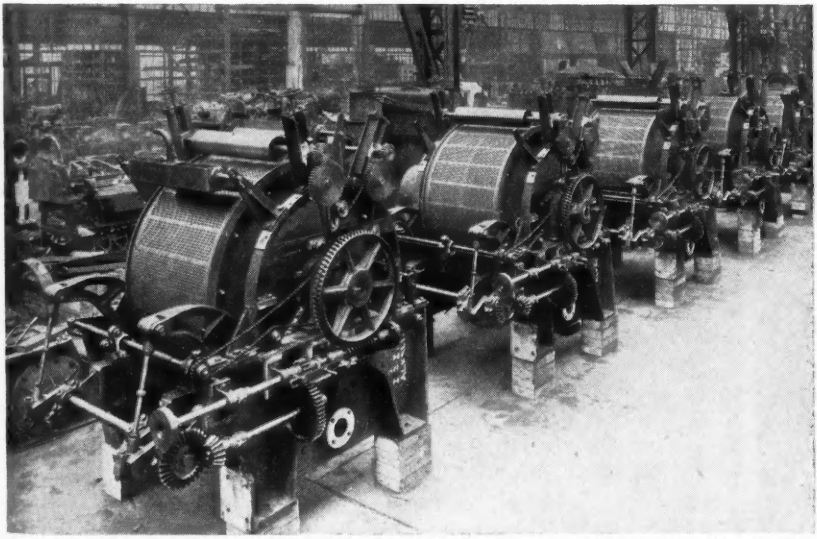
The A.S.P.-Chemical Company is shortly commencing production of a range of deionisation resins, *i.e.*, for cation and anion exchange, and for acid and alkali adsorption. As examples of the direct use of such resins in the manufacture of heavy chemicals, it is intended to produce soda ash and magnesium chloride from sea water, to prepare fluorides from fluospar, and to extract magnesium from dolomite.

These operations must be regarded as major developments in the heavy chemical industry.

Vacuum Filtration

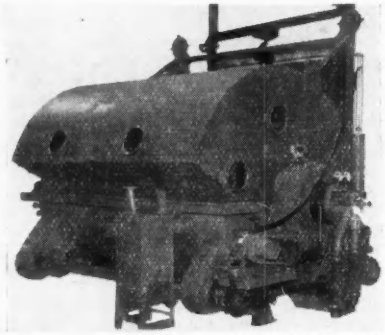
This subject is so rarely mentioned in technical literature that a few remarks of a general nature are justified.

Major developments in filtration equipment as employed, for example, in the heavy chemical and metallurgical industries, are rare. Rotary vacuum filters of to-day, however, are considerably different from those first employed some 40 years ago, and many chemical manufacturers are unaware that the most reliable suppliers design filters for the process in question rather than supply machines of standard design in the hope that



(Courtesy of Dorr-Oliver Co., Ltd.)

Fig. 5. The standard design of the open-type normal submergence filter for continuous vacuum de-watering, useful where washing of the filter cake is not required



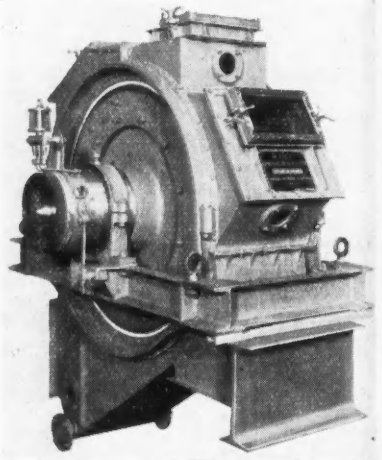
[*Courtesy of Dorr-Oliver Co., Ltd.*

Fig. 1. Enclosed gas-tight vacuum filter for use where there is danger of contamination or leakage of volatile vapours

the machines will function successfully.

An examination of the costs of liquid-solid processes involving continuous filtration reveals the high proportion of the total cost borne by the filtration step, not only with regard to first cost but also with regard to operating costs. It therefore becomes urgently necessary to adopt every possible means to reduce capital and operating filtration costs.

Experience in this field is showing the frequent desirability of thickening the slurry ahead of filtration. Thickening is a cheap operation, and it is generally found that the solids yield of continuous filters is directly proportional to the solids concentration in the feed. Frequently the first cost of thickening and filtration equipment for a given de-watering operation is considerably



[*Courtesy of Dorr-Oliver Co., Ltd.*

Fig. 3. Enclosed top-feed filter dryer for use with free-filtering solids to produce a very dry filter-cake, through which hot air is drawn

less than the corresponding cost when filtration alone is used. Subsequently, it is being found that operational costs for the combined thickening and filtration equipment are very considerably lower than the corresponding cost of filtration alone.

Fresh Advances

The illustrations in Figs. 1-6 show some of the latest type rotary vacuum filters. To-day, continuous vacuum filters are accom-

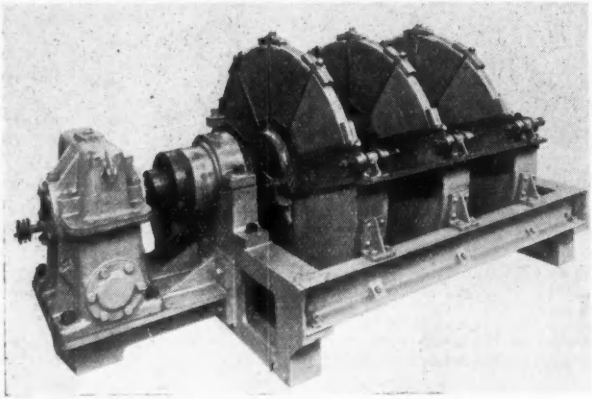


Fig. 2. Disc-type vacuum filter, which affords large filtering capacity in ratio to floor space and facilitates the filtration of different products independently

[*Courtesy of International Combustion, Ltd.*

plishing such difficult filtering operations as de-watering sewage sludge, filtering solutions of satin white, and the clarification of penicillin broths, etc.

Among the latest developments are the rotary continuous pressure, and vacuum, precoat filters. These filters would appear to solve the problem of cloth blinding by using a bed of diatomaceous earth as the filtering medium, and the continuous filtration of slimy solids is becoming a practical reality. As the filter drum revolves, a very thin (0.001 in.) layer of the precoat material is shaved off, either by continuous or intermittent advance of the scraper knife. The rotary pressure precoat filter seems well designed to supply a long-felt need for a continuous pressure filtration machine in order to eliminate the disadvantages of intermittent operation, characteristic of Sweetland, and plate-and-frame filters.

Filter Cloths

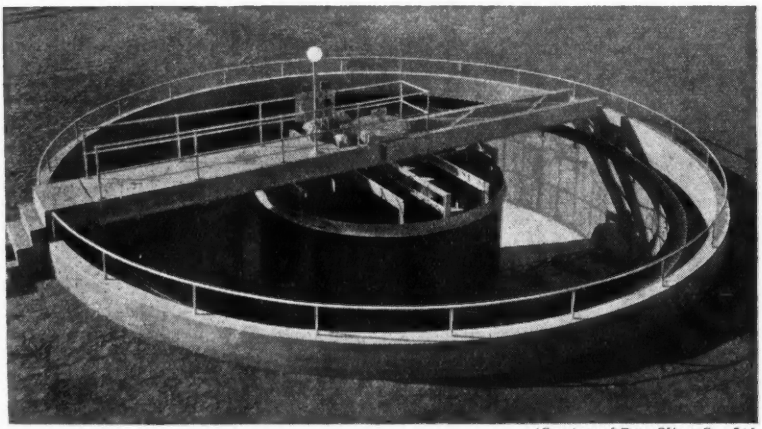
Considerable advances can be recorded in filter-cloth technology. These are chiefly concerned with new materials of fabrication. Thus, filter cloths in Hollander, twill and other weaves are available in Monel and stainless steel. Monel filter cloths have now been in operation for several years, and their long life under corrosive conditions appears to justify the higher first cost. Stainless steel cloths are not quite so satisfactory. Due to the work-hardening properties of stainless steels, the cloths crack under most operating conditions unless special precautions are adopted to prevent the slightest cloth movement. There is a need for a stainless steel which can be drawn into fine threads and which possesses work-hardening properties which, from the aspect of filter cloth media, are not worse than those of Monel.

Plastic filter cloths are becoming available. Vinyon, nylon and saran have been used and have been found to possess very desirable properties of corrosion resistance and long life. However, the upper operational temperature limit for vinyon and nylon is 60° C., and it is believed that saran cloth can be used up to 80° C. There would appear to be a promising future for plastic filter media, in that research is enabling plastics to be synthesised having the required specific properties of corrosion resistance, long life, and temperature stability, coupled with the necessary weaving characteristics.

Plastics

The chief additional items of interest to heavy chemical manufacturers in the plastics field are the use of sprayed plastics to form corrosion- and abrasion-resistant coatings on certain types of plant equipment, and the use of plastics as materials of chemical plant construction.

There is undoubtedly a field, only partially developed, for sprayed plastic protective coatings. The Schori Company, and others, have already achieved commercial successes and are continuing to devote considerable research to the subject. Among the materials used are thiokol, polythene, mixed lead and thiokol, varnishes, the polyvinyls, and



(Courtesy of Dorr-Oliver Co., Ltd.

Fig. 7. Combined, continuous flocculating and settling machine, used in the treatment of waters for colour and turbidity removal, and industrial wastes

acrylic and styrene plastics. Such plastics are among the most chemically inert substances known.

If such coatings stand the test of time, they will prove to be a most useful asset to all chemical manufacturers. To-day, with the wide price gap existing between stainless and ordinary steels—and the long time it usually takes to obtain allocations of stainless steel—the use of plastic coatings, which can be obtained with practically no delay, is attractive.

Versatility of Polythene

With regard to polythene in particular, its extremely high degree of inertness and its freedom from sulphur are useful characteristics. However, its very high coefficient of thermal expansion—some 20 times that of steel—makes one wonder whether the stress induced in a coating due to differential thermal expansion will harm the material or cause detachment of the coating from the metal on which it is deposited. First indications are that the bond holds good. The matter is being investigated and, no doubt, literature on the subject will appear in due course.

Another development in the use of protective coatings relates to plastic pastes, *e.g.*, PVC paste. The paste is painted on the article and then bonded and rendered impervious by a simple heat treatment. The limitation, of course, lies in the difficulty of heat treating large items of equipment.

Before leaving the subject of sprayed coatings it might be well to implore the inventive genius—whoever he may prove to be—to hurry up with the apparently impossible job of devising a method for spraying non-porous coatings of stainless steel on to cast iron and mild steel. Such an invention would be welcomed generally.

Reverting to polythene, this material is quite promising as a material of construction. Its machining properties are excellent; it can be welded very simply with a jet of hot carbon dioxide or nitrogen; its resistance to deformation by mechanical shock, or stress, is particularly remarkable. All of these properties, and others such as its electrical insulating properties, accompany the inertness to highly corrosive chemicals, including hydrochloric acid.

On the other hand, it softens above 60° C.; it is in short supply, and it is expensive. Summarising, it may be said that, as a product of the plastics chemist, it is a fine addition to the list of useful materials of chemical plant construction; however, chemical industry would welcome a similar type plastic having better stability to temperatures up to, say, 300° C., and a much lower coefficient of thermal expansion.

Another of the noteworthy materials which have become available recently is Keebush. This material has already stood the test of many highly corrosive conditions. It is available in rod, tube and sheet form, and has been fabricated into pumps, tanks and impeller blades for mixers and fans. It, too, is expensive, but the high first cost is frequently justified by its long life.

The mention of a plastic capable of stability at high temperatures recalls that new plastics field, the foundations of which were laid during some forty years of research by Professor F. S. Kipping, at University College, Nottingham.

Kipping concluded that the silicones he produced had little commercial value, but it is clear now that, when his conclusion was drawn, he was on the threshold of discoveries of enormous importance.

A Plethora of Materials

The contemporary student of organic chemistry may well be bewildered by the complexity of his subject—by the millions of compounds formed by carbon, together with a very few other elements. We now wonder what will be the nature of that branch of chemistry in which silicon is the principal building-block.

We have seen the beginnings only—and what truly remarkable beginnings they are! We have met silicones that can be drawn into the finest threads; silicones that behave like putty in the fingers; but whose thixotrophy enables them to be bounced like a ball; silicones whose vapour, impregnated on paper and clothes renders such articles completely water-repellent; silicones which can substitute insulating materials, and thereby enable electric motors to be run at temperatures of the order of 300° C., for thousands of hours, without harm; silicone-rubbers which are so heat resistant that we must expect improved similar materials to be used in the manufacture of motor car tyres one day; and liquid silicone-resins which are a basis for heat-resisting enamels and paints.

The development of silicones, stimulated by conditions demanding their application during the war years, has been so rapid, that their future is still a subject for speculation. But it is clear that yet another new industry has been born, and that thereby, the heavy chemical industry, among others, will be sure to benefit.

Progress in developing new materials of construction, which will ease the chemical manufacturers' ever-present worries in this respect, has been one of more gratifying developments in the past year.

Mention has been made of some of the developments in the plastics field. Refractory manufacturers are constantly intro-

ducing improved materials. Their efforts to produce refractories having the desired qualities of infusibility, resistance to "spalling" and thermal shock, resistance to corrosive and abrasive conditions, thermal conductivity, porosity, mechanical strength, etc., have been extremely successful.

Similarly, it is observed that glass is fast becoming a standard material of construction for many cases in which resistance to corrosion, and absolute cleanliness, are essential. The absence of pores, the transparency, and the very low absorption of certain radiations, are additional advantages. Porcelain and Vitreosil also have the desirable property of non-porosity, and these materials are available in many useful forms and sizes. Graphite, the most refractory of materials, has found many applications, and good progress in fabricating plant units has been made.

In the metals field, improvements and developments are so numerous that it is impossible to cover the subject adequately in the space available. The demand for stainless steels is enormous. The iron and steel technologists have provided us with an extremely useful range of alloy steels and special cast-irons, designed for various conditions.

A highly interesting development concerns the fabrication of stainless steel-clad iron, and steel, equipment. Those concerned have been faced by problems of fabrication, such as the difficulty of welding the bi-metal edges when fabricating tanks, and other vessels, from the rolled sheet. However, special techniques have been devised to meet such difficulties, and it is certain that this very desirable addition to the chemical manufacturer's armoury against corrosion, will be widely appreciated.

Fertilisers

Synthetic ammonia plants are in the news again, and interest centres in the new plants being erected in India, the chief contractors being the Power-Gas Corporation, Ltd.

The main principles of the Haber-Bosch flowsheet have not materially changed. The process may still be regarded as a monument to what chemists and engineers can do, given air, water, coal, and anhydrite. The products—aqueous and anhydrous ammonia, nitric acid, ammonium sulphate, ammonium nitrate, urea, carbon dioxide, nitro-chalk, etc., and a useful range of aliphatic organics—form a very important section of heavy chemical industry. It is understood that extensions to the original process—the manufacture of cement, higher alcohols, and sulphuric acid are functioning very successfully.

Spectacular changes are hardly to be expected, but interesting variations of the original Haber-Bosch procedure, characterise plants by the Nitrogen Engineering Corporation of America, and such variations as the Claude, Casale, Fauser, and Mont Cenis processes.

In addition, many developments of the painstaking, less spectacular, variety have taken place. These are credited to the people whose daily job it is to study plant operation and efficiency. Improvements in plant design; in the performance of catalyst and high pressure units; in instrumentation and other methods of plant control; the introduction of new materials of construction—all combine to make these processes more efficient, and more economically productive.

At the present time, new factories are being erected, and existing factories enlarged in this country for the manufacture of fertilisers. These schemes will result in an important addition to the quantity of plant food produced for the farmer. Up to the present time a large proportion of home-produced chemical fertilisers has been made and sold in powdered form, but there is now an increasing demand for fertilisers in granular form.

These fertilisers contain the required proportions of nitrogen, phosphoric acid and potash, in a hard, compact, non-caking, granule, suitable for application to the soil by a modern seed drill. This method of application gives a much more economical distribution of the fertiliser, and is more satisfactory than the old method of distributing in powdered form; a greater yield is obtained for the same expenditure.

One project of great interest is a new factory for the production of triple superphosphate, which is being erected at Immingham in North Lincolnshire, by Fisons, Ltd. Superphosphate in this form contains approximately 2½ times more plant food than is available in ordinary superphosphate. This factory has been designed along the most modern lines, and will be the most advanced factory of its kind in this country.

The design of this new works has benefited from the visits of Messrs. Fisons' engineers to the U.S.A., Canada and Europe. The factory will include its own power station and sulphuric acid plant, and necessitates the installation of new dockside equipment and conveyors. In addition to triple superphosphate production a section of the factory will be devoted to the manufacture of compound concentrated fertilisers in granular form.

The flowsheets of the process are shown diagrammatically in Figs. 8 and 9.

In the phosphoric acid section of the plant,

it is clear that the production of an acid of 30-32 per cent P_2O_5 strength will involve considerably less evaporation to produce the final 37 per cent P_2O_5 acid, than the standard wet process, which yields acid of 20-22 per cent P_2O_5 strength. The advantage makes itself felt in less costly evaporation equipment, and lower steam consumption.

Another item of interest concerns the method of operation of the evaporator section, which has always been a source of trouble due to scaling of the evaporator surfaces. A novel method has been introduced, whereby, by maintaining a relatively large quantity of strong acid in circulation, these difficulties will be almost completely eliminated. Lost time due to maintenance and de-scaling will, in consequence, be greatly reduced.

Sulphuric Acid

Sulphuric acid manufacturers are showing interest in the K.C.P. process, a good example of which has been operating for several years in Italy. The K.C.P. process is a development of the Kachkaroff-M.P. process for the simultaneous production of sulphuric and nitric acids.

The introduction of this process appears to have completed a cycle of developments. It will be recalled that the first chamber process, installed by Roebuck in England in 1746, was equipped with lead chambers only. Subsequently, notable additions to the process were the towers named after their inventors, Glover, and Gay-Lussac. With the introduction, and growing popularity of the contact process, efforts were directed towards increasing the productive capacity per unit volume of chamber space.

Among the better known examples of intensified chamber acid processes now operating are the Mills-Packard, and Gaillard-Parish systems. In the first-named process, the chambers are frusto-conical, with arrangements for external water cooling. In the Gaillard-Parrish process, production is intensified by internal sprays of cool acid which flood the walls, and increase vapour-phase productivity.

The chambers fitted with devices for intensified acid production have often been named tower-chambers. Other types of chamber acid plants have increased the number of packed towers, clearly with the object, all the time, of increasing the proportion of acid which can be manufactured in less costly tower equipment, which is also more efficient and more controllable.

Logical Development

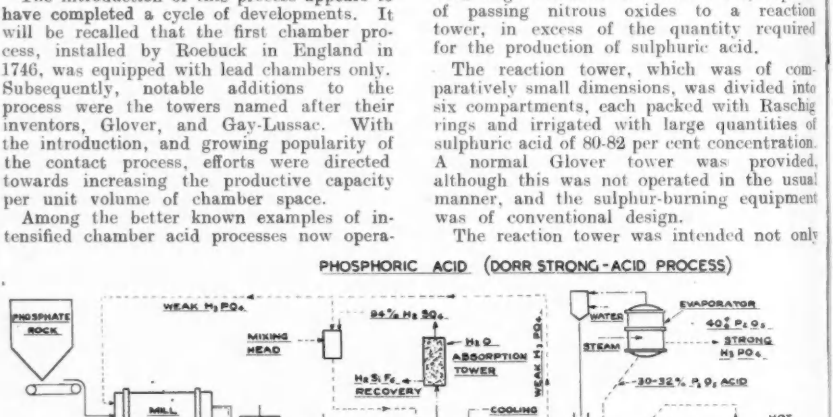
Thus the K.C.P. process, which uses towers only, appears to be a perfectly logical final development. It eliminates the difficulty of nitric oxide recovery, characteristic of the chamber-and-tower systems, by the adoption of a special technique ensuring that all the acid production takes place in the liquid phase.

The Kachkaroff-M.P. process was equipped with large ammonia oxidation units, capable of passing nitrous oxides to a reaction tower, in excess of the quantity required for the production of sulphuric acid.

The reaction tower, which was of comparatively small dimensions, was divided into six compartments, each packed with Raschig rings and irrigated with large quantities of sulphuric acid of 80-82 per cent concentration. A normal Glover tower was provided, although this was not operated in the usual manner, and the sulphur-burning equipment was of conventional design.

The reaction tower was intended not only

PHOSPHORIC ACID (DORR STRONG-ACID PROCESS)



PHOSPHATE ROCK (70 B.P.L.)	2,350 LB.	PER TON OF 35% P_2O_5 ACID
SULPHURIC ACID (94%)	1,950 LB.	
WATER (CHIEFLY COOLING)	7,500 GAL.	
STEAM	780 LB.	
ELECTRICITY	52.5 Kw.-Hr.	
DIRECT LABOUR	0.8 MAN.-Hr.	

Fig. 8

to provide a means for the interaction of sulphur dioxide, nitrogen trioxide, water and oxygen, but to act as an absorption system for the excess of oxides of nitrogen, which could be withdrawn continuously, and subsequently denitrated in a separate system for the recovery of nitric acid. This plant was operated for several years, producing varying proportions of sulphuric acid and nitric acid with remarkable success.

As a result of experience with the Kachkaroff-M.P. process, it was found that if sulphuric acid only were required, then the input of oxides of nitrogen could be regulated so as to maintain a constant nitrosity of the circulating acid of approximately 5 grams of oxides of nitrogen per 100 ccs. Further, if this circulating acid were cooled so as to remove the heat of reaction, a phenomenal rate of production could be achieved. The reaction appeared to take place substantially in the liquid phase, and the formation of gaseous nitric oxide was thereby avoided.

The K.C.P. plant includes a conventional pyrites burner, cyclone dust separator, and Cottrell electrostatic precipitator. The tower system comprises production, denitrating, absorption and recuperator towers, and the auxiliaries include tanks for 60° Bé. denitrated, and nitrosulphonic acids, together with circulation pumps and acid coolers.

Substantial Advantages

From the operation of the K.C.P. and Kachkaroff-M.P. processes, considerable data have been accumulated, from the study of which it is possible to make the following general observations:—

(1) The process appears to provide a real alternative to the existing chamber and contact processes.

(2) There is no doubt that the process is a distinct advance on other intensive systems of sulphuric acid production. Approximately 1 cu. ft. of packed reaction space is provided per lb. of sulphur per day.

(3) The process is flexible, and can be adapted to deal with burner gases of varying sulphur dioxide concentration.

(4) Owing to the possibility of denitrating the acid with relatively cold gases, the initial heat of the burner gases can be used for concentrating the sulphuric acid produced, and in this way it is possible to obtain a considerable part of the sulphuric acid produced in a concentration of 66° Bé, i.e., 95 per cent sulphuric acid.

(5) Constructional costs should not be more than 65-75 per cent of those of the normal chamber plant of similar capacity. Further, the materials of construction are readily obtainable.

(6) There is a distinct economy of floor space.

(7) Process labour costs are similar to those of a normal chamber plant.

(8) Running repairs and maintenance costs may be slightly higher than with a chamber plant; but the costs of long-term repairs and renewals are appreciably lower.

(9) Power costs are almost double those of the normal chamber plant, and considerably in excess of those of similar tower processes.

(10) Large quantities of cooling water are required.

Petroleum Chemicals

The growth of the petrochemical industry, may be considered to be one of the most startling developments in the chemical world in recent years. Although the beginnings of the industry can be traced back to the "middle twenties," the developments recorded appear to have followed a law of geometric progression; and due to the

(*Continued on page* 55)

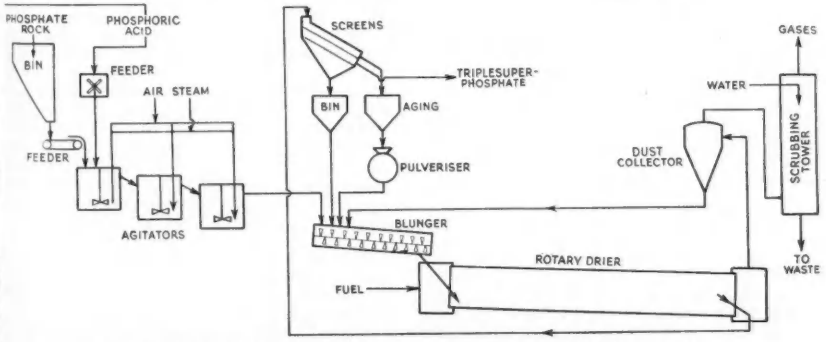


Fig. 9. Flowsheet of the Dorr triple superphosphate process

Production and Use of Ammonium Sulphate

Large Increases in 1946-47

THE substantial changes that have occurred during 1946-47 in the conditions affecting the production and use of nitrogen fertilisers and the changes, even more marked, in production and values since the war are effectively presented in the current annual summary produced by the Sulphate of Ammonia Federation, Ltd.

Outstanding is the great increase in production in this country since the interruption by the war of the customary overseas supplies and the development of greatly increased demand throughout the world. The Federation summarises the total production of sulphate of ammonia and industrial ammonia products at intervals since 1913, of which the following returns for the last year before the war and for 1946 are significant (Table 1).

I.C.I.'s Contribution

During the past year of rather unsettled agricultural conditions, consumption of sulphate of ammonia in Britain was maintained at about the same level as the previous year.

Difficulties arose in connection with the import of wheat and it was necessary for the Government, in mid-autumn 1946 to make a belated and not very successful attempt to increase the wheat acreage. There appeared to be some danger that farmers, particularly in the north and west, were putting their land back into grass at a more rapid rate than was either justified or anticipated. It was believed that this tendency was likely to reduce the demand for sulphate of ammonia. However, the extremely hard winter followed by flooding in many areas seriously affected autumn-sown cereals. This, coupled with the belated sowing of spring corn, stimulated a large demand for sulphate of ammonia for direct application which continued from early in February to the end of May. Weekly orders during March and April beat previous records and the total sales for direct use were some 10,000 tons higher than in the previous year. This increase was offset by a cut in the supply of sulphate of ammonia for compounding rendered necessary in view of the export commitments undertaken at the behest of the Government.

To conform with the official agricultural policy, favouring more livestock products, more barley and oats and less wheat and potato acreage, Imperial Chemical Industries, Ltd., as agents of the Federation, had put into operation a programme of investigation which it was believed would produce convincing evidence of the value of sulphate of ammonia in livestock and grass farming.

For many years, I.C.I. has endeavoured in numerous ways to expand the use of nitrogen on grassland and to bring about a greater realisation of the part that grassland can play in the economy of the farmer and the nation. The extension of the grazing season by early and late applications of sulphate of ammonia to pastures, increasing the output and improving the quality of hay by properly timed applications and methods of conservation such as grass silage and grass drying, had all been investigated and demonstrated over the last decade

The value of nitrogen in livestock farming had hitherto been a matter of faith, but long-term investigation, it is confidently expected, would provide a convincing means of measurement and a firm foundation of knowledge which could be demonstrated and open the way to further expansion in the use of sulphate of ammonia in the home market. These activities in connection with grassland had not in any way reduced the continuous and successful effort to increase the consumption of sulphate of ammonia on arable crops (Table II).

The total shipments of sulphate of ammonia from the United Kingdom for last year, and some previous years, are shown in Table IV. During 1946-47 the Board of Trade, in collaboration with the International Emergency Food Committee continued to allocate tonnages of British sulphate to be shipped to overseas markets. Total shipments amounted to 247,801 tons against 274,589 tons for 1945-46.

Manufacturing Research

On July 1, 1946, pre-war research work was resumed, the main object being to improve the quality of sulphate of ammonia. This work, which is directed by Mr. J. Bell and located at Billingham, was designed to find solutions to manufacturing problems. Quarterly reports were issued and circulated, and from time to time Mr. Bell and his assistants had meetings with technical representatives to discuss the various problems which arose. This department was available to give technical advice and assistance on every phase of ammonia recovery.

Rise of U.K. Prices

Table V shows the prices per ton to British farmers, delivered in 6-ton lots to buyer's nearest station for neutral quality 20.6 per cent N. minimum :—

Since 1934-35 summer prices had been in-

(*Continued on page 54*)

TABLE I

U.K. PRODUCTION OF AMMONIA PRODUCTS
(in tons)
YEARS 1939 AND 1946 COMPARED

Year	Output of ammonia products, basis 25 per cent ammonia (about 20.6 per cent nitrogen)			Included in the total		
	England and Wales	Scotland	Ireland	Total Gt. Britain and Ireland	Industrial ammonia products (basis 25 per cent. ammonia)	Sulphate of ammonia as such (actual tons of product)
					about	about
1939 ...	697,300	72,400	2,800	772,500	182,700	483,300
1946 ...	1,216,500	211,200	2,300	1,430,000	152,500	833,700

TABLE II

AGRICULTURAL CONSUMPTION IN BRITISH ISLES
FERTILISER YEARS 1938-39 AND 1946-47 COMPARED

Fertiliser Year	Sulphate of Ammonia (tons)				Total Nitrogen (metric tons)		
	England, Wales and C.I.	Scotland	Ireland	Total	Sulphate of Ammonia 20.6% N.	N. in other forms	Total N.
1938-39...	134,316	38,756	42,465	215,537	45,111	23,537	68,648
1946-47...	424,000	97,500	40,000	561,500	117,520	48,480	166,000

TABLE III

WORLD PRODUCTION AND CONSUMPTION OF FIXED NITROGEN FERTILISERS
(in metric tons)

	1946-47		1938-39	
	PRODUCTION	CONSUMPTION	PRODUCTION	CONSUMPTION
EUROPE (*a*)	1208.5	1338.5	1833	1692
Belgium	127	90	95	57.5
France	164	201	167.5	202
Holland	47	96	106.5	97
Norway	97	23.5	97.5	13
United Kingdom	296.5	218	171	98
Rest of Europe (*a*)...	477	710	1195.5	1224.5
ASIA	197	341.5	524.5	566.5
China	4	55	—	122
India	6	39.5	4.5	22
Ceylon	—	8.5	—	8.5
Japan	187	221	520	371.5
Rest of Asia	—	17.5	—	42.5
AFRICA	18	79	9.5	106.5
Egypt	—	49.5	—	78
Rest of Africa	18	29.5	9.5	28.5
OCEANIA	6.5	17	5.5	18
AMERICA	1410	1054	590.5	492.5
U.S.A. (*c*)	966	978.5	303.5	443.5
Canada	186	33	61	17
Chile	257	9.5	225.5	6
B.W. Indies...	—	5	—	4.5
Rest of America	1	28	0.5	21.5
WORLD TOTAL	2840	2830	2963	2875.5

(*a*) Including Russian Zone of Germany. (*b*) 1945/46 figures relate to Fertiliser N. only.
(*c*) Including Hawaii and Puerto Rico.

TABLE V

RISE OF U.K. SULPHATE OF AMMONIA PRICES

The following were the prices per ton to British farmers, delivered in 6-ton lots to buyer's nearest station for neutral quality 20.6 per cent. N. minimum :—

	1930/31	1932/33	1937/38 to 1938/39	1939/40	1940/41 to 1945/46	1946/47
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Summer	8 17 0	5 5 0	7 3 6	7 3 6	9 11 6	9 12 6
Spring	9 10 0	6 10 0	7 14 0	9 6 0	10 2 0	10 3 0

creased by 1s. 6d. per ton per month up to the spring price. Since 1940-41 prices to farmers had been "pegged" and producers had received a subsidy on home agricultural sales to cover increases in cost not included in the price. For 1946-47, 1s. per ton was added to the price to cover the increase in rail rates.

World demands for nitrogen fertilisers which continued to exceed existing supply, would be dealt with by the International Emergency Food Committee in Washington in the 1947-48 period. This was an alteration from the arrangements for the 1946-47 season when the Committee was also responsible for allocating phosphate and potash.

TABLE IV

EXPORTS OF SULPHATE OF AMMONIA

(in tons)

FERTILISER YEARS ENDED JUNE 30

TO	1938/39	1945/46	1946/47
Scandinavia ...	—	—	50
U.S.S.R.	—	—	—
Holland and Belgium	5	4,871	1,249
France	—	19,981	—
Portugal	19,428	—	—
Spain	5,842	—	—
Italy	—	—	—
Rest of Europe ...	499	9,918	735
Palestine	2,002	4,570	13,759
Rest of Levant ...	697	2,971	4,131
India and Burma ...	66,027	130,795	108,241
Ceylon	18,257	32,813	35,495
Malaya and British Borneo	23,880	782	18,467
Dutch East Indies	221	—	—
China and Hong Kong	33,761	1,105	7,607
Japanese Empire ...	—	—	—
Rest of Asia ...	1,078	—	1,413
Madeira	1,282	—	—
Canaries	12,392	—	—
Egypt	2,428	8,708	683
Sudan	2,856	7	—
West Africa ...	61	883	126
East Africa ...	1,112	815	3,330
South Africa and Rhodesia ...	16,818	2,581	4,140
Mauritius	10,258	—	2,500
Rest of Africa ...	5	499	203
Australia and New Guinea	35,552	23,368	17,549
New Zealand ...	4,860	—	—
Fiji Isles	4,011	1,250	1,910
Canada and Newfoundland ...	149	—	—
U.S.A.	—	50	642
Central America ...	8	—	5
British West Indies	15,550	14,454	12,535
Rest of West Indies	—	—	—
British Guiana ...	11,043	12,079	7,211
Peru	1,032	—	—
Rest of South America	147	40	105
TOTAL	291,261	272,540	242,086
Channel Islands ...	1,678	338	1,309
Eire	28,929	1,711	4,406
TOTAL EXPORTED	321,868	274,589	247,801

Records Broken in 1947

U.S. Production and Trade Peaks

AS 1947 ended, United States factories, power plants, mines and petroleum industries were producing the greatest physical volume of goods, minerals and power in peace-time history. Employment, states the U.S. Information Service, was close to the 60 million mark.

1947 was the first year since 1930 in which the U.S.A. Government has had a balanced budget. The Treasury closed the books on its fiscal year on June 30 with a $753,787,000 surplus. At present, the budget surplus is $1,386,405,000. The national debt, which was about $280,000 million in 1946, has dropped below $257,000 million for the first time since June, 1945.

Post-War Peak

The seasonally-adjusted index of industrial production of the Federal Reserve (Bank) Board, which measures physical volume of output, moved up two points in November to 92 per cent above the 1935-39 average, a new post-war peak rate. In November and the first half of December, output of durable goods expanded somewhat further, reflecting largely increases in activity in most machinery, transportation equipment, and non-ferrous metal-fabricating industries. Output of steel in early December rose to new post-war peaks, reaching 97.8 per cent of capacity. Output of lumber and other construction materials was maintained in large volume.

Manufacture of non-durable goods continued to increase in November, reflecting mainly a further marked rise in activity at cotton textile mills and an expansion in volume of livestock slaughtered as a result of reduced feed supplies and high prices for feeds. Liquor production was curtailed in November in accordance with the Federal Government's programme to conserve grain.

Still Rising

U.S. foreign trade, both imports and exports, increased substantially in October over the September level, according to the monthly trade report of the U.S. Department of Commerce. Both export and import figures for October represented a progressive upward trend in comparison with 1939, 1946 and September, 1947.

Imports were worth £491.5 million in October. The monthly average for 1939 was $193.1 million and for 1946 $400.1 million. Imports during September totalled £481.2 million.

DEVELOPMENTS IN THE HEAVY CHEMICAL INDUSTRY—(*Continued from page 51*)

security restrictions on publication existing during the war years, we now find ourselves grappling to comprehend a highly specialised new branch of chemical technology.

The hydrocarbons from petroleum available for chemical processing range from methane to high molecular weight aromatics. From these, by processes involving hydrogenation, de-hydrogenation, polymerisation, isomerisation, thermal and catalytic "cracking," etc., hydrocarbons of practically any structure can be produced.

Among the products are hydrocarbons of the paraffin and ethylene series, alcohols, aldehydes, acids, ketones; a wide range of oils for degreasing, detergent and wetting-out purposes; oil-soluble sulphonates for emulsifying, dispersing and corrosion-inhibiting purposes; aromatic extracts for extending linseed oil and resin, and substtutes for oils, gums and resins.

By halogenation processes, and by interaction with synthetic ammonia, the petrochemical field has been still further extended.

Thus, at a time when there are world shortages of many essential basic materials, the fruits of research in the petroleum industry are contributing very considerably to ease the position; in addition to providing highly compatible substitutes, many new and valuable substances are becoming available.

Industrial Wastes

In a recent lecture, Mr. H. W. Cremer, president of the Institution of Chemical Engineers, has again drawn attention to the fact that too many of our watercourses are polluted, and are therefore offensive and unable to support fish life.

The whole problem is complicated and doubts have been expressed as to whether the Rivers Bill, recently introduced to the House of Lords, is adequate for its purpose.

It is agreed that something is being done to ameliorate the situation. The Water Pollution Research Board is doing magnificent work. Manufacturers are at last becoming resigned to the fact that they must install effluent plants. Increasingly, chemical manufacturers are including provision for effluent plants in their schemes for new factories. Effluent plants are costly. It happens, all too frequently, that the cost of the effluent plant required to discharge a treated waste conforming to Royal Commission Standards is intolerably high. Royal Commission Standards were set before scientific investigation had, in many cases, devised economical treatment schemes, and each new problem involves considerable research work

It is therefore suggested that the setting up of official regulations stating the minimum degree of purification to be invariably attained is not a wholly satisfactory procedure. It would be more reasonable if each case were judged separately by a board of inquiry, containing proportionate representation of the interests concerned, and advised by chemists and chemical engineers with special experience.

Finally, what is the viewpoint of the equipment manufacturer? He is anxious to help, but he does not always receive full consideration. Too frequently effluent problems are put up to him which involve the expense of much laboratory research work, engineering work, estimating work, and the usual overhead expenses, by chemical manufacturers who cannot resign themselves to purchasing the treatment plant suggested.

Before leaving the subject of industrial wastes, it seems desirable to draw attention to an equipment machine developed in recent years and which has already proved its paces in many waste treatment problems, besides being highly successful in the field of water treatment. It is designed for difficult problems of solids removal and colour removal. It comprises a central compartment containing a slow speed, vertical, agitator mechanism, surrounded by an annular settling compartment.

The function of the machine is to receive a suitably dosed water, or effluent, in the central flocculating compartment where, by means of gentle agitation during a specified detention period, the solids to be removed are flocculated or otherwise increased in size, so that when the treated liquid flows into the outer clarifying compartment the bulk of the solids is quick to settle. The settled solids are gathered by revolving rakes to a central discharge pipe, from which they are removed as a thick sludge by a pump. The sludge is then filtered, or lagooned, as the case may be.

Conclusion

In a revew of this nature omissions are inevitable, such as the production of magnesium, basic magnesium carbonate, and dead-burnt magnesite, from dolomite and sea water; developments in the electrolytic and electrothermal fields; new and changed techniques in the chemical side of atomic energy plants, and progress made in the alkali industry, such as the introduction of continuous causticising plants.

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[1] THE CHEMICAL AGE, June 21, 1947, p. 795.
[2] *Engineering and Mining Journal*, Vol. 148, No. 11, November, 1947.
[3] *B.P.* 586,131, November 3, 1943.
[4] *Chemical Engineering*, January 1947, p. 105 et seq.

PROGRESS IN DRUGS AND FINE CHEMICALS

by G. COLMAN GREEN, B.Sc., F.R.I.C., A.M.I.Chem.E.

A FULL year has passed since penicillin was made available for retail sale on prescription (S. R. & O., 1946, No. 731; Draft Rules and Orders, 1946, of the Therapeutic Substances Amendment Regulations, 1946). Already much concern has been expressed both in the technical and lay Press concerning the alleged waning power of penicillin over pathogenic organisms, especially those micro-organisms of the *Staphylococcus* species. The inclination, at the moment, is to ascribe this situation to the production of, or the selective survival, of penicillin resistant strains through indiscriminate use of the remedy which alone, it is thought, accounts for the enormous increase in the consumption of the drug.

Too Hasty Development

This aspect of penicillin is one of prime importance because the vast amount of thought, work and money which has been devoted to the problems of production and use of the drug will be brought to nought if, in fact, penicillin resistance is becoming widespread.

There are many workers who will claim, correctly, to have foreseen this development and it was, indeed, their insistence which ultimately brought penicillin under control, so that it became available only on prescription. Many will claim that control should have been even more strict than it has been, pending the clear demonstration that the development of penicillin resistance in normally susceptible micro-organisms was not a serious risk.

Many workers in the field have concluded, in the light of *in vitro* experiments, that penicillin resistance was not easily acquired by pathogens or, if it were, was not of a permanent nature. Similar conclusions have been drawn from work with laboratory animals. There seems, therefore, to be a discrepancy between the results of experimentation in the laboratory and what, it is claimed, is happening "in the field" and this discrepancy appears to be of a degree to cause considerable disquiet. The full seriousness of the position remains to be seen in the light of further experience, assuming the alleged waning power of the drug is, indeed, confirmed.

Barber (*Brit. Med. J.*, November 29, 1947, 863) has very recently pointed out that penicillin is now used in hospitals in large quantities and shows that the strains of *Staphylococcus aureus* now commonly inhabiting certain hospital wards are becoming increasingly penicillin resistant. She expresses the view that the resistance is not an acquired one; but that current infections are due to strains of *S. aureus* which survive by a process of selection in penicillin-treated infections. In one hospital, patients with staphylococcal infections resistant to penicillin increased from 12.5 per cent of the total cases in April-November, 1946, to 38 per cent in February-June, 1947; while, in one unit the increase was from 16.25 per cent to 56.0 per cent in the corresponding periods.

The Medical Theory

The *British Medical Journal*, November 29, 1947, 874, suggests that these observations confirm the general experience that penicillin is waning in power. The existing evidence is summarised and suggests that there are two distinct types of *S. aureus*, one being a producer of the penicillin-destroying enzyme, penicillinase is therefore, naturally penicillin resistant; the other being incapable of producing penicillinase is naturally susceptible to penicillin.

It is suggested that these latter may be gradually succumbing to widespread penisillin usage with the consequence that the penicillin resistant type is becoming more common.

The view is expressed that "the present enormous consumption of the drug can be accounted for only by a good deal of indiscriminate use and it is generally conceded that widespread use, particularly in inadequate doses, is a potent factor in breeding resistant strains of bacteria."

There is some consolation, perhaps, to be found in the fact that the concrete evidence offered by Barber is available only from one particular hospital and refers to one particular organism. These demonstrable facts are to be seen against the backcloth, as it were, of a generally developing feeling among clinicians that penicillin effectiveness is not what it was. If Barber's work should prove to reflect a general trend, then the position is serious indeed since, at the moment, penicillin is the one effective and safe agent in staphylococcal infections.

Few Entirely Resistant

Miller (*J. Amer. Med. Ass.*, 1947, *135*, 749) has expressed views on the development of resistance to antibiotics and particularly against penicillin and streptomycin. He points out that "susceptibility" and "resistance" are relative terms and that by "resistance" is meant that more antibiotic is required to prevent multiplication

of the organism than is required by most other strains of the same bacterial species. In the case of penicillin, few strains of bacteria are resistant to concentrations of penicillin ordinarily attainable in human blood which is a fortunate circumstance.

Some strains of staphylococci are, however, resistant and some highly resistant. Nevertheless, *acquired* resistance is rare during clinical treatment in man because infection is usually brought under control before the causative organism has time to develop resistance. Furthermore, Miller considers that penicillin is now so plentiful that doses may be administered in excees of the minimum quantity required to bring the infection under control and an adequate margin, therefore, normally exists to compensate for any development of resistance.

The determination of whether a given infecting organism is penicillin resistant or not requires careful bacteriological diagnosis otherwise misleading conclusions may be arrived at. For example, persistent gonorrhoeal urethritis may be ascribed to penicillin resistance by genococci when, in fact, the genococci may have been eliminated by the drug and the residual infection may be due to penicillin resistant secondary invaders.

Miller agrees that there is little doubt that penicillin resistance may be induced *in vivo* as well as *in vitro*; but he considers that there is little convincing evidence that the resistance is induced during clinical treatment. The controversy, therefore, remains in suspense until further evidence becomes available.

Penicillinase

It has been mentioned already that it seems probable that, as Spink has pointed out (*Proc. Soc. Exper. Biol. and Med.*, 1945, *59*, 188), penicillin resistance depends upon the ability of the micro-organism to secrete the penicillin destroying enzyme, penicillinase. The study of this enzyme is of considerable importance since it may intervene to abort both treatment by and production of penicillin. It is, for example, ineffective to administer the drug *per rectum* because this portion of the gastro-intestinal tract is inhabited by a penicillinase producing flora. It was at one time thought that the oral administration of penicillin was of low efficacy for the same reason, at least, in part. But, as mentioned below, the loss from this cause has recently been shown to be negligible.

In penicillin manufacture, especially by the submerged process, it is essential to sterilise most carefully the vast quantity of air used for aeration of the fermenting medium, because a few infecting organisms may produce sufficient penicillinase to destroy the penicillin in a batch.

Penicillinase is, further, essential in the test for the sterility of penicillin and its preparation, while it is also essential in the recovery of *B. anthracis* both from blood and media containing penicillin and from animals receiving penicillin therapy.

Hitherto, only crude preparations of penicillinase have been available for such work as this. These crude preparations have been obtained from crushed cells of *E. coli*, from cells and culture fluid of paracolox organisms and extra cellularly from *B. subtilis*. Coghill *et al.* obtained a good yield of *crude* enzyme from an unclassified spore-former of the *B. cereus* group (*Arch. Biochem.*, 1945, *8*, 377). Le Page (*J. Biol. Chem.*, 1946, *166*, 465) describes a method for the production of the *purified* enzyme from a member of the Bacillaceæ coded NRRL 596, from which maximum yields were obtained extracellularly in buffered yeast extrast broth.

The enzyme was isolated by adsorption on "Hyflo-Supercel," from which it was eluted by ammonium hydroxide. Further purification was achieved by precipitation wth 100 per cent ammonium sulphate saturation after preliminary removal of impurities at the 50 per cent saturation level. 1.0 mg. of the purified penicillinase completely destroyed 100,000 units of penicillin (say, 100 mg. amorphous penicillin) in 10 minutes.

Another Approach

Hoasewright and Henry (*J. Biol. Chem.*, 1947, *167*, 552) describe a similar method of preparation of the purified enzyme in which the enzyme is adsorbed on "Filter-Cel" from which 50 per cent to 100 per cent of the activity is recovered by elution with 0.8N ammonia of *pH* 10.0. Prior to adsorption the liquor is centrifuged and filtered through sintered glass. Filtration through asbestos is not possible because of adsorption.

In this method *Bacillus cereus* (NRRL B-569) is incubated at 20-37°C. in corn steep liquor or a synthetic medium containing amino acids and chalk to give a *p*H 6.5-8.5. For maximum yields penicillin itself must be added at the rate of 200 units/ml. initially and again at 24 hours. Peak yields of penicillinase occur in these conditions at 96 hours with corn steep and at 120 hours with synthetic media. Penicillinase thus prepared remains stable after 3 months at 8°C. and *p*H 10.0

Additional Legislation

During 1947 further legislation has been enacted to control the sale of all preparations containing penicillin (Penicillin Act, 1947). This Act defines penicillin by oblique reference to the Therapeutic Substances Act, 1925, which has been amended to include penicillin, and defines it.

The interesting differences between the definition of "penicillin" in this amendment and the definition in the agreement between H.M. Government and the Government of the U.S.A. (Treaty Series No. 4, 1946, Cmd. 6757) was discussed in last year's Annual Review at some length.

The raising of the minimum potency from 300 International Units per mgm. to 900 I.U.s per mgm. is of no practical significance, since manufacturers have produced penicillin of a higher purity for some time. Powers have also been taken to apply a control similar to that applied to penicillin to other preparation which have similar characteristics.

Rising Output

So far as Great Britain is concerned, figures for penicillin production have not been accessible in the past. But the *Digest of Statistics* issued by the Central Statistical Office now gives figures for the production of penicillin retrospectively. Since it has not been possible to quote them before they are set out *in extenso*. The figures refer to weekly averages in thousands of mega-units:

1944:		0.7
1945:		6.0
1946:		60.0
1947:	January	53.2
	February	54.3
	March	74.5
	April	90.0
	May	95.0
	June	89.4
	July	94.5
	August	96.7
	September	122.6

Thus, towards the end of 1947 penicillin production in Great Britain was running at a weekly average production of 122 mega-units or over 6000 mega units per annum. This compares with a reported production of over 7 million mega-units in 1945, over 25 million mega units in 1946 in U.S.A.

The market for the drug in America is reported to be very competitive; 100,000 units of penicillin reached the lowest figure of rather less than $1 in January, 1947. This compares with a figure of $20.00 in 1944 which promptly dropped to $8.00 when deep fermentation operations first commenced. The Americans report that the export market has become increasingly competitive during 1947. This is due to increased competition between American manufacturers; British manufacturers are reported not to have kept pace.

Production and Distribution

The principal British deep fermentation plant is situated at Speke near Liverpool and has been operated hitherto by The Distillers Co., Ltd., as agents of the Ministry of Supply. As already announced, the factory was taken over, as from December, by The Distillers Company (Biochemicals), Ltd. To acquire the factory from the Minister of Supply it is reported that the capital will be raised to £1,000,000. The entire output of this factory will be distributed, both for home and export trades, through seven firms: Allen & Hanbury's, Ltd.; Boots Pure Drug Co., Ltd.; Burroughs Wellcome, Ltd.; Evans Medical Supplies, Ltd.; Imperial Chemical (Pharmaceuticals) Ltd.; Pharmaceutical Specialities (May & Baker), Ltd.; and the British Drug Houses, Ltd.

An outline of both the Speke submerged fermentation and the Glaxo surface fermentation processes was given in the Annual Review last year. A description of one of the two penicillin processes established in the Western United States of America has now become available (*Chem. Eng. Prog.*, 1947, *43*, 155) by T. H. M. Taylor. The process is operated by the Cutter Laboratories in Berkley, California, which annually produces penicillin products valued at $2½ million.

American Plant

Interesting features of process and plant are that the 5000 (U.S.) gallons fermenting vessels are steam pressure vessels clad internally with stainless steel and are equipped with cooling and heating coils fabricated in this material. Other essential equipment in these units includes turbine-type agitators and chargers.

The wort is sterilised *in situ* at 15 lb. p.s.i. and, after cooling, is innoculated with 150 galls. mould spores by aseptic technique. Sterile air is blown into the fermenting vessels at a rate of at least 400 cu. ft. per minute through the sparger and the turbine stirrer is run simultaneously. Airflow rate, temperature, pressure, and addition of anti-foaming agent, are all automatically controlled.

Phenylacetic acid is added to enhance the yield of penicillin G (benzylpenicillin), a point which will be referred to later. The fermented liquor contains 500-1000 Oxford units per ml. with a purity of 10 units/mg. dry weight.

The following extraction and purification processes resemble substantially the procedures adopted in this country which have been described in earlier Annual Reviews. There are, however, a few details which are not generally known here. For example, filter aid is used on the rotary mycelium filter; the amount of carbon required is 2-2.5 per cent w/v and about half-an-hour is required for adsorption; the cast iron plate and frame press in which the adsorbate is filtered is plastic coated; after elution with 80 per cent aqeous acetone, the crude peni-

cillin in the acetone has a purity of about 100 units/mg. dry weight, the overall recovery now being about 60 per cent of the penicillin in the fermentation liquor.

The aqueous aceton solution of penicillin is warmed to 65° F. and sprayed into the first stage of a 3-stage stainless steel vacuum evaporator. At a pressure of 3 in. mercury (abs.) the 80 per cent acetone is evaporated to 10 per cent acetone in this stage. The liquor from this stage now passes through a heat exchanger to the second stage which is operated at 1 in. mercury (abs.), the concentration being reduced to 6 per cent acetone. In the third stage the acetone content is reduced to 0.5 per cent.

There follows an amyl acetate and then a chloroform solvent extraction operation at 2° C., when the penicillin is purified to 950 units/mg. dry weight.

The aqueous solution from the solvent extraction operations is passed to a flash-evaporator operating at 40° F. and a pressure of 0.1 in. mercury (abs.). The concentrated solution is passed through a bacteriological filter of the Seitz asbestos pad type and is then freeze-dried either in final containers or in bulk.

100 Per Cent Increase

A very striking comparison is afforded between the physical circumstance and the implied economics of the surface and deep fermentation techniques by the fact that the existing Cutter plant produces more than 100 billion Oxford units a month, compared with the one billion Oxford units a month of the surface fermentaton for which it was originally designed.

A number of factors such as improved strains of mould have, of course, contributed in no small measure to this situation. However, subsequent to the acetone evaporation the plant is identical with that originally laid down for purification of the 100 billion Oxford units a month surface fermentation. This satisfactory state of affairs turns upon the high concentration achieved in the carbon adsorption and acetone elution process. The substitution of the carbon adsorption and the batch solvent extraction processes by continuous countercurrent solvent extraction is now projected, when a greater penicillin recovery and a reduction in cost are contemplated.

The actual preparation of the "seed" for the innoculation of the fermentation vessels is a matter of some consequence. As in most industrial fermentations, this preparation involves considerable cost and may contribute substantially towards the reduction of overall yield calculated on the carbohydrate consumed.

Savave and Brook (*J. Bact.*, 1946, *52*, 385) have described a technique by which the volume of "seed" required for an innoculation is reduced, the number of steps in the "seed" preparation is reduced and, what is more important in penicillin manufacture, the risks of contamination are correspondingly reduced.

This technique consists in passing the "seed" through a high-speed propeller type blender. The result of this treatment is that mycelial clusters are broken up without damage to growth or fermentation capacity. Fragmentation of the mycelium was found to take place usually at the septa. In shaker flask penicillin fermentations it was found that diluted 1 : 40,000 such "blended" "seed" adequately substituted "unblended" "seed" at a dilution of 1 : 10.

Trend in U.K. Production

Meanwhile, in Britain, penicillin continues in rather short supply, despite increasing production, and still only a small proportion of the total output is in the form of the pure, white crystalline type which has a potency approaching 1600 units/mg. The bulk of the production continues to be in the form of the light yellow amorphous preparation of potency around 1000 to 1200 units/mg.

It has been found that the use of the pure variety is not without its disadvantages because it has become increasingly apparent that with increasing purity disproportionately larger amounts of penicillin have had to be administered to secure the desired clinical response. This has been ascribed to the presence of an enhancement factor which would have been removed in preparing penicillin of the highest commercial potency. The reports were so consistent that larger doses of the purer penicillin were required that investigations were set in hand and the first characteristic of the enhancement factor present in amorphous penicillin which were determined was that it was one or more strong organic acids. Ultimately, Fishback *et al.* (*Science*, 1947, *106*, 373) isolated ortho-hydroxyphenylacetic acid by a chromatographic procedure and this was found to be an enhancement factor *in vitro*.

Studies *in vivo* are proceeding; but preliminary evidence shows that when penicillin is injected with orthohydroxyphenylacetic acid blood levels at the end of 30 minutes are from twice to sixteen times the level obtained after that period by the injection of penicillin alone.

Enhanced Persistency

As reported in previous reviews, great efforts have been made to develop techniques which would enable penicillin blood levels to be maintained for a longer period than is normally possible.

The necessity for such techniques follows from the factor that penicillin is excreted through the kidneys with such readiness that there is always difficulty in maintaining desired bacteriostatic concentrations of the drug in the blood stream. Indeed, the use of enhancement agents to obtain these higher than normal concentrations is indispensible where infections are due to micro-organisms which are relatively insensitive to penicillin, as well as in cases where, for idiosyncratic or other reasons, the patient is unable to maintain reasonable blood levels with even massive doses of penicillin.

Clinical Problem

One of the earlier techniques involved the administration of *p*-aminohippuric acid which seems to compete with penicillin for the diffusional sites in the kidney tubule and to secure preferential secretion. The use of *p*-aminohippuric acid is, however, objectionable on a number of scores. Since it is ineffective by mouth daily dosages of 200 to 240 grams have to be administered intravenously. This has a sclerosing effect on the vein and may produce unpleasant side-reactions.

It has now been briefly reported that one of the large American penicillin manufacturers is marketing a crystalline, water-insoluble salt, penicillin-procaine, which, on injection in man at an equivalent strength of 300,000 units penicillin in oil, is said to produce detectable blood after 24-48 hours.

Injection of penicillin intramuscularly in beeswax-peanut oil, according to the now well-established procedure of Romansky is a routine which secures steady release of penicillin from the depot thus created with the consequent maintenance of the desired blood concentration over effective periods of time. The method is not, however, without its objections. There is the difficulty of the prevention of solidification of the solution in the syringe; the effect of penicillin particle size on the rate of release from the oil-wax depot; the risk of local reactions and foreign body tissue response; unsatisfactory stability at room temperature.

Promising Results

In a search for a means by which these objections might be overcome it occurred to Monash (*Science*, 1947, *106*, 370) that the penicillin which Abraham and Chain had found in the early days of penicillin therapy to be irreversibly inactivated by metallic ions might, in fact, be activated *in vivo*. This was found to be the case. In one experiment he found that when 20,000 units of penicillin per kilogram of bodyweight was injected into a rabbit, the drug being suspended in beeswax-peanut oil, there was no detectable blood level after 5 hours. On the other hand a similar injection of silver penicillinate gave titres of 0.08 units/ml. after 17 hours and 0.03 units after 20 hours. Similar results were obtained with mercury and iron salts of penicillin. Further, salts of penicillin with organic bases were also effective; 20,000 units per kilo of brilliant green penicillinate gave a titre of 0.16 units/ml. after 18 hours while a similar injection of gentian violet penicillinate gave a titre of 0.04 units/ml. after 18 hours.

An alternative to the oily medium is offered by Loewe *et al.* (*J. Lab. Clin. Med.*, 1947, *32*). It consists of a combination of penicillin G with ephedrine sulphate and adrenaline dihydrochloride as vasoconatrictors to confer prolonging effect, together with eucupine dihydrochloride (as local anæsthetic) and gelatin-dextrose mixture. It is claimed that the preparation is stable at room temperature for more than a year, is a homogeneous, water-soluble powder, is non-toxic and free from local reactions and is easy to administer. It has been found in some hundreds of cases that measurable blood-levels may be maintained with this mixture for 24 hours or more.

Auxiliary Aid

Another procedure for the prolongation of the period over which effective penicillin blood levels may be maintained has been developed by Beger, of Sharpe & Dohme (*Science*, 1947, *105*, 94). This consists in the administration of "caronamide" which is 4'-carboxyphenyl-methane sulphonanilide and is claimed completely and reversibly to inhibit the tubular excretion of the various penicillins without inhibiting either the venal transport of glucose, amino acids and urea or sulphonamide resorption, glomerular filtration or ammonia formation. (Seeler *et al.* (*J. Lab. Clin. Med.*, 1947, *32*, 807) found that blood levels following intromuscular administration of 100,000 units of penicillin every 8 hours in patients receiving minimum effective doses were significantly greater than blood levels achieved by the administration of three times this quantity of penicillin without caronamide.

The mode of action is not at present clear. It has already been pointed out that *p*-animohippuric acid inhibits the secretion of penicillin by competition with the antibiotic for the tubular secretory apparatus. Diodrast (or Diodone; 3 : 5-diiodo-4-pyridone-N-acetic acid) is reported to act in the same way. But caronamide is excreted through the glomerular filtrate and not through the tubules. It is tentatively supposed that caronamide acts by some inhibition of an enzymatic process concerned with the excretion of penicilln.

(*To be continued*)

Chemical Injection Pumps

Adaptable Variable Stroke Designs

PRACTICALLY all branches of chemical industry have reason to be interested in the "Minor" range of chemical injection pumps manufactured by The Candy Filter Co., of Church Road, Hanwell, London, W.7.

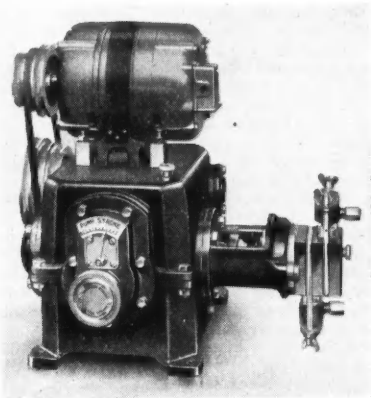
These are precision pumps of the positive ram type designed for the accurate measurement and application of chemical solutions and are widely used for handling a variety of liquids in industry, including the injection of reagents in process work, conditioning of boiler feedwater and administration of sterilising solutions in water treatment.

The pump is driven by a fractional horsepower electric motor, mounted on top of the gearbox, and the pump and motor shafts are fitted with interchangeable, triple-groove veebelt pulleys so that six different pump speeds are available, and this in conjunction with the variable stroke device enables a wide range of outputs to be covered by any given pump. A calibrated stroke indicator fitted above the stroke-changing handwheel enables the stroke setting to be immediately adjusted as required.

A large number of standard pumping heads is available, the materials of construction being varied to suit the working conditions and solution to be handled.

For dealing with corrosive solutions, such as sodium hypochlorite, the pump body can be constructed of moulded ebonite or plastic with a polished glass ram working in a gland fitted with synthetic rubber sealing rings, the valve housings being in transparent plastic with synthetic rubber valves.

Where it is necessary to handle alkaline and other solutions, for example, in process work, or in the feeding of boiler conditioning chemicals, pump heads are available with the body constructed from mild steel or stainless steel with polished stainless steel ram, and the valves, housings and seats also in stainless steel. Capacities with this construction in the "M" range vary from 1.25 g.p.h. in the simplex form against 1200 lb p.s.i. pressure to 8.5 g.p.h. in the duplex form against 400 lb. p.s.i.



The standard M Type pump of 4·25 g.p.h. capacity

I.C.I.'s NEW DYESTUFF

IMPERIAL Chemical Industries, Ltd., which in 1935 introduced Monastral Fast Blue, the fastest organic blue pigment, reports production by the Blackley laboratories of the Dyestuffs Division of an entirely new type of dyestuff, Alcian Blue 8GS, which promises to be the basic of a new range of dyestuffs. It represents the first of several years' work by two research chemists, Messrs. N. Haddock and C. Wood.

The new dyestuff is said to be eminently suitable for printing textiles, particularly cotton, giving bright turquoise shades hitherto unobtainable, with fastness properties comparable with vats, Brenthols and Soledons.

It can be printed on linen, viscose, spun viscose and cuprammonium rayons, acetate rayon, natural silk, chlorinated wool, nylon and paper. Of particular interest is the fact that the shade remains practically constant on different materials. The fastness properties of Alcian Blue 8GS are given as follows: Light fastness of a 1½ per cent print against S.D.C. Standards is 5-6 on cotton and varies from 4 to 5 on other fibres; the shade becomes a little duller, which dullness is removed by washing, resulting in a true tone-in-tone fade.

An exceptionally high degree of resistance was exhibited in other tests, severe washing with boiling soap and soda, rubbing and reduction tests.

The dyestuff is water soluble, and therefore free from the troubles associated with dispersed dyestuffs and those water-soluble dyestuffs that are sensitive to electrolytes.

Printing and fixing of the Alcian Blue 8GS are characterised by their simplicity. Printing pastes consist of an acidic substance such as acetic or lactic acid, and alkaline material such as sodium acetate, the dyestuff itself and a thickening agent such as starch or a starch-tragacanth mixture.

A NEW FUEL POLICY

Prevailing Coal Conditions Call For Fresh Techniques

by Dr. G. E. FOXWELL

THE year has been of historical importance to the fuel industry. On January 1 the National Coal Board entered into possession of the coal mines and of half the coke ovens and certain other assets, and the previous owners were dispossessed with, of course, some form of compensation, the extent of which still appears to be in doubt. A Bill for the nationalisation of the electricity industry was passed through all its stages in Parliament. The Minister of Fuel and Power announced that a Bill for the nationalisation of the gas industry would be introduced early in 1948. The weather in the early part of the year gave the most convincing demonstration yet seen of the utter dependence of British industry on fuel and the disastrous consequences of failure to supply it in the necessary quantities.

These various events are not unrelated. The last-mentioned point, the dependence of industry on fuel, should be a signpost to the future activities of the Coal Board and of other nationalised fuel industries; present indications, however, have not indicated that the real significance of this demonstration has been realised by those in control.

Lost Impetus

The nationalisation of the coal industry may be considered as good or bad according to its ultimate results and according to the political views of the individual. Regarded objectively, however, there should be certain very great advantages to be gained by bringing the whole coal industry under a single direction. There are many who felt, and who still feel, that nationalisation was not the best means of doing this. It was widely suggested that the effect would be over-centralisation and, after the fly-wheel effect of past habits had lost its impetus, the machine would slow down because the individual would lose his enthusiasm. So far as can be judged from private advices this is already happening. Every proposal for improvement, especially that involving new plant, must be considered by committees or other authority at headquarters with the result that, whereas under private ownership the decision could have been taken within a day, a week or a month, proposals now appear to be lost for months at headquarters, with the result that a good deal of the initial enthusiasm of many for technical improvements in the coal industry is waning.

It is to be hoped that this fault is not inherent in nationalisation, but that it is only a temporary and local difficulty due to over-centralisation in the organisation of the National Coal Board. Increases in the price of coal during 1947 have been far more pronounced than improvements in the quality of the material. It has been said with a certain amount of cynicism that the mining industry is leaving no stone unturned to increase output.

The price of coal has increased by 26s. a ton at the pithead since 1939. This considerable increase is not altogether out of accord with increases in the price of other materials. Nevertheless, it is widely felt that it is the duty of the Coal Board to increase output from the mines so as to reduce labour cost per ton of coal mined. Most of the 26s. increase has been due to increases in the cost of labour.

Miners are probably working as hard as they did before the war, thanks to a successful effort to secure their full co-operation. Drastic increases in output a man-shift can be secured, therefore, only by technical measures involving mechanisation and reorganisation. The Reid report suggested that the greatest single requirement was increased use of underground conveyors. The number of underground conveyors installed has increased from 1982 (in 1946) to 2900 (in 1947) and it is planned to be further increased to 4000 in 1948. The number of coal cutters delivered—677 in 1946—has been increased to about 800 in 1947, and is to be increased to 1000 in 1948.

The natural conditions in British coal mines prevent the adoption of mechanisation to the same extent as in America so that, with our output of 2.85 tons a man-shift at the coal face, we cannot hope to equal the very much greater outputs of American miners. It is, however, a striking fact that whereas only 25 per cent employed in British mines actually produce coal, the comparable figure in the United States is about 70 per cent. That is one of the major problems of reorganisation facing the Coal Board and it is reassuring to know that British mining engineers are thinking very seriously about this problem and are already doing whatever can be done immediately to meet it.

Better Use of Coal

The net result of the year's working has been some increase in the output of coal, comparatively little change in its quality

which still remains very much as it was in the later years of the war, and a very considerable increase in price. The fear has been expressed that the price of coal will never be materially reduced because the power exerted by the National Union of Mineworkers is such that the miners will successfully claim as increased wages the greater part of any reductions that may be made in the cost of obtaining coal

Possible Benefits

The nationalisation of the mines, however, brings with it the possibility of very considerable improvements in the utilisation of coal, in its preparation and in the whole structure of the industry; for the first time it is possible to put into effect a national policy without having first to convince hundreds of individual owners and directors that the policy is good.

One extremely valuable piece of work that has already been done—work that was, in fact, started under private ownership—was to draw up a rational system of coal grading to reduce very substantially the number of sizes of coal. Although this size grading was not adopted formally in 1947, the foundations were laid and it appears likely that a simplified and rational system of coal sizing will be adopted during the coming year.

Dr. E. S. Grumell has advocated that there should be set up a new system of price structure; that the relative prices of the various sizes, types and qualities of coal shall be fixed with reference to three factors: (1) The number of heat units in the coal, (2) the efficiency with which those heat units can be used, taking into account the effect of moisture, ash, etc., and (3) the utility or convenience factor covering capital and maintenance costs and taking into account the many practical features which accompany the use of any particular grade of coal.

The data on which many of these factors can be assessed has not yet been determined, but in general the proposed system has a great deal in its favour for all coal used for combustion purposes; it is less certain whether it could be applied to coal carbonisation.

Fluctuating Values

Industry is particularly interested in this because there have been in the past the anomalies that a particular grade of coal has been sold very cheaply because of the difficulty of using it, and as soon as that difficulty has been overcome the price has risen so considerably that the labour of the inventors has been wasted.

There have also been the difficulties of firms supplied with coal high in ash or moisture or unsuitable as regards caking properties for the appliance in which it is to be used. These coals are frequently used, although their composition or characteristics are unsuited to the appliance, with an efficiency much lower than is necessary and yet they have been charged for at the full price. There is very great need to ensure that for each appliance the proper type and size of coal is supplied and that any excess of incombustible material shall be fully allowed for in the price.

The nationalisation of coal, electricity and gas introduces the possibility of setting up a rational national policy. There are purposes, such as steam raising for which raw coal can be used with a very high efficiency, and unless the chemical industries find an urgent use for the by-products from carbonisation it would seem desirable that coal should continue to be used in the raw state for those purposes. On the other hand, there are many other purposes, mostly connected with heat treatment in one form or another, for which raw coal is less suitable than gas or coke and in respect of which the coal should be carbonised for use.

More Carbonisation

Col. W. M. Carr has put forward the case for carbonising a much greater proportion of our coal. He believes that by carbonising whatever coal cannot be burned with high thermal efficiency in the processes in which it is now employed we could save some 50 million tons of coal a year out of the national coal requirements of 200 million tons.

Industry is calling for gas on a very large scale. Between the years 1937 and 1943 the 76 gas undertakings owned by the United Kingdom Gas Corporation (of which Col. Carr is managing director) increased their yearly sales of gas to industrial users from 938 m. cu. ft. to 3052 m. cu. ft., an increase of 211 per cent in the period or 35 per cent each year. A ten-year gas plant expansion plan might quadruple the capacity of the gas industry and in this way could lead to the saving of 50 million tons of coal a year.

The difficulty of putting this or any other plan into effect at the moment is, of course, the chronic shortage of materials and plant which has put a stop to so many practical schemes for works expansion that are in themselves highly desirable. It is a tragic commentary upon our present condition that the advantages and financial gains to be secured from increased carbonisation of coals are recognised but cannot be implemented for reasons outside our control.

The possibilities of laying down an official national fuel and power policy have been examined by P.E.P. in a report "The British Fuel and Power Industries" pub-

lished in October 1947. The fuel and power industries have been exhaustively surveyed in this report with particular reference to their history during the last ten years or so, and it has been pointed out that since coal is the only important indigenous source of fuel and power, special importance attaches to the regulation of coal prices. The relationship between the prices charged to gas undertakings, electricity undertakings and industrial and domestic consumers must have an important influence on the trend of fuel usage. It follows from this that once the technical bases of a fuel and power policy have been set up the Government, or whatever Boards direct those industries, can secure that their policy should be implemented by suitable price tariffs. The P.E.P. Committee has suggested that the first step would be for a national authority to lay down certain general conditions relating to consumption which would have as their object to reduce to a minimum the total cost to the community, to ensure that the best possible fuel service is available, and to reduce to a minimum the total consumption of coal. Once the policy was laid down there would be set up a tariff commission in each of the fuel and power industries, the main functions of which would be to secure uniformity of the forms of tariff in industry, in accordance with actual costs of production and supply. A project of the same kind is being studied in France.

Why Export?

Coal surveys have shown that we shall be without coal in a measurable time, within 150-200 years. The whole industrial might of this country and our position among the Powers depends on having a sufficiency of coal at the right prices. But is it not strange those now responsible for coal talk of exporting the maximum quantity in order to balance the export budget? In so doing they are mortgaging our national future. Nearly a century ago scientists proclaimed that coal was not inexhaustible and that it should be conserved. It took many decades and two major wars to bring that fact home to the British people. But our coal reserves continue to be exported so that we are possibly within a generation or two of a complete coal famine.

Mr. Wakefield Adam had the courage to proclaim this fact before the Institute of Export. We may have to export a little coal, as a man sells his heirlooms, to save ourselves from immediate bankruptcy; the long-term policy must be to concentrate upon the production from coal of goods for export that will be many times the value of the coal from which they are produced. Raw coal should not be exported.

The coming nationalisation of the gas industry has brought to a head the question of whether coke ovens should be owned by the N.C.B. and should supply gas to the gas industry or whether all forms of carbonisation outside the steelworks should be controlled by a National Carbonisation Board. Some in the gas industry base their judgment of this problem on the belief that the gas industry is more important and efficient than the coke-oven industry. This is not necessarily true. There are well-managed and badly-managed plants in both industries.

Gasification at Pit-Head

Coke-oven managers, considering primarily the quantity of coal carbonised in each plant daily, point out that the scale of coke-oven operations is far greater than that of most gasworks and that the proper thing to do is for them to supply the gas from the pit-head and for the gas industry to distribute and sell it. (We may interpolate here that in Czechoslovakia, the most promising system is considered to be total gasification of solid fuel at the pit-head in Lurgi pressure producers manufacturing gas of 18 atms. pressure and 425 B.Th.U./cu. ft. C.V. which, on account of its high pressure can be distributed over long distances without cost for compression for transmission.)

The National Coal Board finds in coke ovens a source of considerable revenue and, having set up a coke-oven department, is unwilling to allow it to pass into other hands.

How the decision will go remains uncertain. Some three or four years ago the present writer in a paper to the Coke Oven Managers' Association put forward the case for a national carbonisation board and still believes that there are many advantages to be gained by single ownership of all carbonisation plants outside steel works. This board, however, should not confine itself to the production of coke and gas, but should undertake the production of chemicals up to the stage of intermediates at least, not only from the by-products of carbonisation but from any other processes based on coal, coke, coal gas, and water gas, that may be devised.

Pulverised Fuel

Two important conferences have taken place during the year. The Institute of Fuel in June staged a conference at Harrogate on Pulverised Fuel. Never before in this country has so much information been concentrated on this subject. To all users of pulverised fuel the transactions of this conference will be of the very highest value.

The use of pulverised fuel in the cement industry, in the non-ferrous metals industry, for stationary gas turbines and for many other purposes, in addition to boilers and furnaces, was considered in a large number

of papers. The conference papers can still be obtained from the Institute of Fuel.

America is blessed with plentiful oil and coal and is using both liberally—perhaps prodigally. In Scandinavia, where there are no indigenous coal deposits, every possible use is made of electricity generated from water power. In France, where coal reserves are as short as ours will be in a generation or two, every possible development of water power is being encouraged and the use of coal, particularly raw coal, is being reduced to a minimum. For the same reasons the electrification of transport is making rapid progress in many countries, particularly in Sweden. In Russia, the vast expansion of industry by successive 5-year plans has directed attention to the use of low-grade fuels down to peat for firing power station boilers and to an intensive study of the chemistry of combustion and of the economics of fuel utilisation. In Hitler's Germany, lignite was largely developed for many purposes—chemical and combustion. The proposal has been made (THE CHEMICAL AGE, March 8, 1947, p. 293) for a completely mechanised peat industry in Scotland, the peat being used for the production of electricity and gas, and as a material for chemical, insulation, agricultural and horticultural purposes.

Alternative Sources of Heat

There are in Sweden some 25 spray units operating on waste liquors from wood pulp mills. In these systems the black liquor, containing about 60 per cent of solids, is spread into a water-cooled furnace forming part of the steam boiler of the soda recovery plant.

In Belgium, the chemical industry is closely linked with the coke ovens and the gas industry and there are advocates of a still closer linkage whereby everything possible that can be used in the chemical industry is taken from the gas and the highly purified residual gas is then supplied for town and industrial purposes.

The cost of coal gas may be 3 to 6½ times as great as an equal thermal value in raw coal. But the undoubted large increase in demand for town gas for industry suggests that generally the advantages of gaseous fuel considerably outweigh its higher price per therm, even without taking into account the saving in coal which is so essential

Fischer-Tropsch Principle

The chemical utilisation of coal has proceeded in practice to a greater extent in Germany than anywhere else. The position here is very interesting because it appears that the production of oil from coal, and equally the production of many chemicals from gases from the Fischer-Tropsch process, can only be economic if coal is cheap.

Drs. Hall and Parker have estimated that the cost of producing petrol from coal by the Fischer-Tropsch process would be of the order of 2s. 6d. a gallon under present prices and they have concluded that the process would become comercially feasible only when a raw material can be secured at a price of the order of 5s. a ton. It seems, therefore, that it is impossible to consider the setting up of Fischer-Tropsch plants in this country or in any other country in which the price of coal is high. It may be possible, however, to use these processes for the production of chemicals in other parts of the Empire, particularly on low grade coal.

Much the same applies to hydrogenation of coal although, of course, hydrogenation of oil is in a different category. Nevertheless it is interesting to note that the developments at Billingham as disclosed in papers by Major Gordon to the Institute of Fuel, have been applied in the petroleum industry with very great success to certain grades of oils. Similarly, the petroleum industry is finding that natural gas, which commands a very low price at the oil wells, can be used economically for the production of synthesis gas for the Fischer-Tropsch process and there have been considerable developments in America, particularly on the part of the Standard Oil Company.

The development of the fluidised technique by this company, particulars of which have been published during the year, may well lead to a revolution in the methods of bringing about chemical reactions between solids and gases or between gases in the presence of a solid catalyst. These developments have been described by Dr. J. G. King in a paper to the Institution of Gas Engineers and by the present author (*Coke and Gas*, September 1947).

The present writer is extremely gratified to notice the trend in the direction of home refining of petroleum, which he has advocated for many years.

Home refining of petroleum gives British manufacturers of plant an opportunity to gain experience in one of the most important industries in the world which has hitherto been confined to American chemical and oil engineers. It also gives to the British chemical industry the opportunity of producing chemicals from oil fractions and refinery gases which has developed in America because of the country's extensive refineries. In most of the very large projects for the refining of oil in this country revealed during the year it is proposed to undertake the manufacture of chemicals from the by-products of oil refineries.

PROGRESS IN GAS CHEMISTRY

By L. T. MINCHIN, B.Sc., M.Inst. Gas E.

THE disadvantages of the old method of removing H_2S from town gas by passing it through layers of iron oxide have been apparent for a long time; and present labour difficulties have made the need for an alternative method more pressing. At Manchester two million cubic feet of gas per day are now being purified by a liquid method using a suspension of ferric hydroxide in ammonium carbonate.

The ammonium salt absorbs the H_2S rapidly, and a slower reaction follows in a settling tank in which iron sulphide is formed. This sludge is oxidised by air in special towers giving rise to elementary sulphur and ferric hydroxide, and can then be used again for washing out more H_2S. Periodically, some of the material is drawn off, filtered and pressed to a cake containing some 70 per cent of sulphur.

Sulphur Compounds

In addition to H_2S, crude gas contains organic sulphur compounds which are only partly removed by ordinary gasworks processes. A thorough and methodical survey of the occurrence of these compounds has just been completed,[2] and it is shown that about 50 per cent consists of carbon disulphide, the rest being carbon oxysulphide and thiophene.

Mercaptans, which were previously thought to be another minor constituent, are now shown to be present only in extremely small traces. Methods are available for dealing with organic sulphur compounds but no really satisfactory way of removing all three at once is known. Complete sulphur removal therefore would necessitate both an oil washing or active carbon process (which removes CS_2 and thiophene) and a catalytic hydrogenation (which affects CS_2 and COS).

Gas Manufacture

The fuel crisis has caused much attention to be given to emergency methods for cracking oil in gasworks.[3] This was done principally by spraying oil into retorts either with or without steam and air. The possibility of spraying oil into the coke in water gas generators was also examined. Most of these methods gave rise to a gas very rich in unsaturated hydrocarbons and of a high density; at East Greenwich some attempt was made to increase the proportion of paraffins by using contact surfaces of bauxite.[4]

In the long-range programme consideration continues to be given to the hydrogenation of coal and the synthesis of methane. Both these processes are being worked by the Gas Research Board on an experimental plant at Poole, Dorset, and the 8th report of that Board[5] describes some careful experiments which have been made to follow the course of the reaction through the fuel bed by using a large number of thermocouples embedded in it.

Work is also progressing on the methods of prolonging the life of the nickel catalyst used in the synthesis of methane. Considerable attention has been focused on the "fluidised" technique as used in petroleum refineries,[6] and the possibility of using this method to control the many reactions between solid and gas phases is being much discussed.

In one suggested process,[7] for instance, powdered coal would be carried in a stream of hydrogen-containing gas into a carbonisation chamber, possibly under pressure. The powdered coke produced in this first chamber would then be carried to a second chamber in a stream of O_2 and H_2O and here the bulk of the carbon would be gasified by the water-gas reaction. In a third chamber the water gas so produced would take up a powdered catalyst (perhaps nickel of molybdenum sulphide) and some methane synthesis would take place to enrich the water gas and thereby increase its suitability as a fuel. Another somewhat similar method has been patented by I.C.I., Ltd.,[8] so that further developments may be expected.

Thermal Losses

The normal method of gas-making by two stages—carbonisation of coal followed by the manufacture of water gas from some of the resulting coke—entails a number of thermal losses which make it difficult to increase the overall efficiency of the works much above 75 per cent. In consequence there is great interest in methods of one-stage gasification such as the Lurgi process, which was very greatly developed in Germany and is one of the principal sources of the gas used in the Czechoslovakian grid.

In this process steam and oxygen are supplied to a producer containing coal at 20 atmospheres pressure and at the relatively low temperature of 800°C. The high pressure enables the CO_2 to be removed by solution in water, and the method is particularly suitable for use at a coal-field site because the gas can often be fed into a long distince pipe-line without further compression. The conditions of temperature and pressure in the reaction vessel are chosen to give the maximum yield of methane. No Lurgi producer is yet working in this country, but it

(*Continued overleaf*)

Important Indian Mineral Finds

Basis of Increased Industrial Plans

LARGE quantities of pyritic material which can be utilised for the manufacture of sulphuric acid have been discovered in Mysore, South India, according to an article in the Indian *Journal of Scientific and Industrial Research*. The Mysore Geological Department has discovered a promising pyritiferous ore body in the Chitaldrug district estimated to yield about half a million tons of pyritic material with a sulphur content varying from 25 to 42 per cent in an area of about 100 acres so far surveyed. A large body of graphite schists estimated to yield 50,000 tons of the ore at a depth of 10 to 15 ft. and suitable for pencil making, lubricants, foundry facings and electrodes has also been discovered through the application of geophysical methods.

* * *

Investigations carried out under the auspices of the Council of Scientific and Industrial Research have shown that most of the Indian vegetable oils can be successfully employed as diesel fuels. Cottonseed oil, in particular, gives exceptional performance in that its consumption is less than that of mineral oils. Despite their good performance, however, the use of vegetable oils for this purpose is being delayed owing to the present high cost of production.

* * *

The industrial economy of Eastern Pakistan depends upon the results of current field investigations into mineral deposits. One of the most important finds is iron pyrites which have been located in the Chittagong area. Analysis has shown that it contains as high as 95 per cent of iron sulphides which are useful for the manufacture of sulphuric acid.

* * *

Russia has promised to supply India with 15,000 tons of ammonium sulphate, which is additional to the allocation made by the International Emergency Food Council.

Allocations of ammonium nitrate have been made by the Agriculture Ministry to the Provinces and States in India for the sugarcane and similar crops. During November, 12,850 tons of chemical fertilisers were received from abroad.

Progress in Gas Chemistry *(Continued)*

seems safe to prophesy that something on these lines will appear before long.

A feature of 1947 has been the final report of the team workers led by J. W. Wood on the combustion characteristics of town gas at fourteen different points in the country.[9] Until some sort of standardisation of gas quality is achieved this report will be of value in indicating the behaviour of a burner in different parts of the country. It also provides a mass of data from which more generalised deductions can be made as to the effect of gas composition in both the luminous and the bunsen flame.

Another feature of the Institution of Gas Engineers' meeting has been the reviews of wartime literature on flame velocity,[10, 11] much of which was overlooked or unobtainable during the war. Of particular importance seems to be the effect which turbulence has in enhancing flame velocity and flame temperature.

Gas as a Chemical Raw Material

Another trend which may be discerned as one reviews the past year is an increased interest in coal gas as a source of chemicals. A paper given in 1946[12] discussed the great importance of ethylene as a raw material, and predicted that the day would come when we should be shocked at the idea of using this gas simply as a fuel.

The 1947 report[5] referred to another possibility, namely, the direct chlorination of methane gas to give substituted methanes, and, in particular, carbon tetra chloride. Some preliminary experiments in the laboratory have shown that this reaction is catalysed to a considerable extent by the film of carbon formed on the walls of the tube. Further work is proceeding.

Gas Research Board

The Gas Research Board had an unfortunate start in life, for the war broke out before it was properly established, and since then such experimental work as has been done has been divided between Leeds, South Kensington and the experimental plant at Poole. We are glad to hear that the Board has at last been successful in finding a building of its own, and 1948 will see the headquarters established at Beckenham in South London.

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INDUSTRIAL LEGISLATION IN 1947

by Our Legal Correspondent

A GREAT volume of legislation is to be expected from a Parliament so industrious that it sits on August Bank Holiday and the day of the Royal wedding. During the session which ended in November, 55 new Acts were passed; this was fewer than in the previous session, but the proportion of Acts which were lengthy and complex increased.

No legislation was introduced to deal with the chemical industry as such. But a large number of the new measures were so sweeping that they affect industry as a whole, while others touch on the chemical industry at a particular point.

Economic Control

The most drastic of the new Acts was one of the shortest. The 1945 Supplies and Services Act was amended to include new purposes for which regulations might be issued. The existing powers enabled the Crown to issue regulations to assist demobilisation and reconversion of industry and to ensure a sufficiency of essential supplies and services, equitably distributed, at fair prices. Some doubt was expressed as to whether these powers would be sufficient to cover regulations which the Government intended to issue to deal with the economic crisis which developed in the summer.

New powers were therefore taken to issue regulations for the following additional purposes :—

(a) For promoting the productivity of industry, commerce and agriculture.

(b) For fostering and directing exports and reducing imports or imports of any classes from all or any countries and for redressing the balance of trade.

(c) Generally for ensuring that the whole resources of the community are available for use and are used in a manner best calculated to secure the interests of the community.

Control of Exchange

The Exchange Control Act provides for a permanent control, on the same basis as the control exercised during and since the war, over dealing in British and foreign currency, gold and securities. It draws a distinction between foreign currency and currency of scheduled territories, which is less restricted. The scheduled territories include the British Empire (except Canada and Newfoundland), Egypt, Sudan, Iraq, Transjordan, Iceland and Faroe Islands.

Before very long chemical concerns may receive an official request for information under the Statistics of Trade Act. This enables the Government to obtain " the information necessary for the appreciation of economic trends and the provision of a statistical service for industry and for the discharge by Government departments of their functions." The Board of Trade is to take a census of distribution and services at intervals for the purpose of providing a general survey of the state of trade and business. The information given by individual firms is not to be made public.

Development Acts

Linked with this measure is the Industrial Organisation and Development Act which provides " for the establishment of development councils to exercise functions for improving the service rendered to the community by industries." No mention is made in the Act of the industries in which these councils are to be set up. They are to consist of employers' representatives, workers' representatives and independent members. A council will have power to prepare a register of businesses in the industry and to require information from each business as to productive capacity, capital assets, staff, output, orders, sales, deliveries, stocks and costs. This information is to be kept secret.

A council may levy those in the industry to provide itself with the necessary funds. Its functions may include the promotion of research, of training, of safety measures, of improved marketing and of exports. Before establishing a council the President of the Board of Trade must consult both the workers' and employers' representatives in the industry.

Chemical firms which wish to expand will have to consult the new Town and Country Planning Act, which greatly extends the previous planning powers.

Position of Employees

The National Service Act provides for conscription during peacetime. The rights of the employee who is called up are safeguarded by the provisions as to reinstatement. These are very similar to the provisions already in force for those called up during the war.

Employees in Crown establishments are benefited by the Crown Proceedings Act, which enables them to sue the Crown as a legal person. In addition to being liable for torts, *i.e.*, civil wrongs, such as negligence, the Crown is to be liable where one of its servants or agents, acting within his authority, infringes a patent or registered trade mark or copyright.

Under the Transport Act railway wagons which were the private property of chemical undertakings will be transferred to the

Transport Commission and compensation will be paid. The most important point to the chemical industry about the Transport Act is an omission. A business with a "C" licence for road transport is not caught by the Act.

The Penicillin Act controls the sale and supply of penicillin and such other antibiotics as may be designated. But it does not interfere with the wholesaler. The tax rebate allowed on delivery of hydrocarbon oil for home consumption has been increased by a penny.

The Finance Act also imposed a profits tax of 12½ per cent on distributed profits and 5 per cent on undistributed profits. Parliament had before it proposals to double this tax in the supplementary Budget at the time this article was written.

Company Law

This review of legislation would not be complete without a reference to the new Companies Act, a most comprehensive measure containing 109 clauses and eight schedules. Chemical concerns will need to pay particular attention to the provision as to accounts and to directors.

Every public company must keep books which will explain its transactions and give a "true and fair" view of the state of its affairs at intervals of not less than three months. Similarly, the annual balance sheet must give a "true and fair" view of the state of the company's finances at the end of the year and must be prepared in accordance with rules laid down in one of the schedules. The accounts must also show the position of subsidiary companies.

Directors are more strictly controlled. They must disclose their age and must retire at 70. Tax free payments to directors are prohibited. Payments for loss of office may not be made, unless they have been disclosed to the company and approved by it. The annual accounts must contain particulars of directors' salaries. This new Act has been generally welcomed.

Statutory Rules and Orders

With the gradual reduction in controls over the supply and price of raw materials, the number of Statutory Rules and Orders issued during 1947, which affect the chemical industry, has shown a drop as compared with previous years.

The most important of the new Orders have been issued during the past few months and affect employment generally. The new Control of Engagement Order requires that the engagement of men aged 18-50 and women aged 18-40 shall be made through local Labour Exchanges or Appointments Offices, or through approved employment agencies. Advertising by employers of vacancies must be done through the same medium. Managerial, professional, administrative or executive jobs are excluded from the Order. Persons serving in the armed forces and women having children under 15 living with them are also excepted. It will remain in force until December 31, 1948.

The Registration for Employment Order gives the Minister of Labour power to require any group of persons within the above age limits to register particulars about themselves. He may also require specified undertakings to register particulars of themselves and their employees. But this does not apply to undertakings engaged in essential work. Married women living with their husbands are exempt.

Price Controls

Special conditions which applied to sale of Lend-Lease machine tools have been revoked. Magnesium, magnesium alloy and scrap have been freed from control by the Ministry of Supply. The control of coir, china clay and agar has been revoked.

Sulphur. A new Order has been issued increasing the maximum price which may be charged for ground sulphur.

Sulphuric Acid. An amending Order provides for additions to the price list in the 1940 Order. Hitherto these additions had been authorised in directions issued under the Order. Now they appear in the Order itself.

Molasses and Industrial Alcohol. A new Order has been issued consolidating previous Orders and providing increased maximum prices for all the materials controlled by the Order, except molasses supplied for the production of cattle food. Controlled materials are molasses, plain British spirit and absolute alcohol, methylated spirit and finish, acetone, acetates and butyl alcohol, acetic acid and acetic anhydride.

Coal Tar Products. A new Order has been issued consolidating and amending previous Orders and providing for increases in the prices of all description of naphthalene and road tar. Permits granted and directions given under the 1943 Order are continued in force. The following products are now covered by the Order—anthracene, naphthalene, road tar, coal-tar acids, creosote oils, coal-tar oils and strained anthracene oil.

Copper, Lead and Zinc. Five amending Orders have been issued during the past year. Last Christmas, maximum prices of copper, lead, zinc and zinc products were increased. Hot rolled copper wire rods were released from acquisition and disposal licensing.

Copper, lead and zinc were the subjects of several statutory price increases earlier this year.

Dr. J. G. Malloch (left), Chief Scientific Liaison Officer of the National Research Council of Canada, who contributed the Neil Mathieson McWharrie Lecture—summarised here—at the Royal Society of Arts. Sir Edward Appleton (right) was the chairman

SCIENTIFIC RESEARCH IN CANADA

Closer Collaboration with Britain in 1948

by Dr. J. G. MALLOCH, M.B.E.

CANADA'S population of 13 million is very small in proportion to the size of the country. Correspondingly, her scientific manpower is small in relation to the magnitude and diversity of her problems. Also, the small population cannot support an expenditure on research to the amount possible in the United States or even the United Kingdom.

Nevertheless, the real limitation has always been men and not money and this has been particularly true in recent years. Because our effort has been limited, the attack of some of our obvious problems has been delayed or at times tackled with inadequate resources in order that we might concentrate on some urgent major investigation.

Dual Influence

In science, as indeed in most aspects of our national life, we are influenced on one hand by the proximity of the United States and on the other by our strong personal and historical ties with the U.K. In material things we are closer to the United States, but in our mode of thought, and particularly in our viewpoint on organisation, the British influence predominates.

Freely and gratefully as we acknowledge our twin debt, we have not been content that Canadian science should be a somewhat blurred double reflection from our physical and spiritual neighbours. As Canada, under the impact of two great wars, has progressed through adolescence to young adult nationhood, Canadian science has been emerging with a distinctive and purely Canadian approach to its problems.

Since 1916

Industrial research in Canada is of comparatively recent origin mainly because our secondary industry owes its inception to the first great war and its major development to the second. In 1916, when the Government established the Honorary Advisory Council for Scientific and Industrial Research, commonly called the National Research Council, its first enterprise was to conduct a survey which showed that there was no industrial research and that there were insufficient scientists in training.

The real operations date from the passage of the Research Council Act in 1924. This Act constituted the Council as a corporate body capable of deriving income from sources in addition to the Government appropriation. It gave very wide powers indeed for the conduct and support of research in any field of science or technology, but no control over existing institutions.

With the goodwill of the other research organisations, the flexibility resulting from these two provisions has enabled the Council to occupy a key position in Canadian research. It supports the supply of trained

scientists by providing scholarships and bursaries. It encourages research in universities by grants-in-aid made either directly or through its associate committees. Through these committees and other devices those interested are enabled to co-ordinate their attack on major problems.

It operates several large research stations, the most important being the main laboratories in Ottawa, the Aeronautical Laboratories and the Radio Research Station just outside the city, the Atomic Energy Research Establishment at Chalk River, and two recently-established regional laboratories, one at Saskatoon, Saskatchewan, and the other at Halifax, Nova Scotia. With the wide powers conferred by the Act the Council could embark on any field of research, but in actual practice it does not duplicate the work of other organisations.

Decisions as to where a particular piece of work will be done are generally on a rather informal basis, and as a result it is sometimes difficult to draw any sharp line between the activities of the Council and other laboratories. For example, while metallurgical research in general is done by the Department of Mines and Resources, the Pidgeon magnesium process which achieved such importance during the war was developed in the National Research Laboratories. The Chemistry Division is interested mainly in textiles, laundry, paint, rubber, particularly synthetic rubber, certain industrial chemicals and other products. The Division of Physics operates laboratories dealing with heat and insulation, optics, with particular reference to aerial photography and mapping, sound and acoustics, radiology, metrology and electrical measurements.

Industrial Laboratories

The Ontario Research Foundation and, to a lesser extent, the National Research Laboratories, carry on work on specific problems financed by industry, but research by industry itself in Canada is not of great magnitude. Most of our large concerns with sufficient resources to maintain research organisations are subsidiaries of the United States and, to a lesser extent, United Kingdom companies, and the research laboratories are generally maintained outside the borders of Canada.

There are, of course, some large industrial research organisations—those of the Shawinigan Chemical Company and the Consolidated Mining and Smelting Company are perhaps best known. Gradually, however, industry is developing its own research facilities.

In the early part of the war, before Pearl Harbour, many of the Canadian companies found that information urgently required for war contracts was not available, and that the research could not be undertaken by the parent companies in the United States. This experience, together with some encouragement by way of income tax relief, is leading to the establishment of laboratories by quite a number of firms.

The universities have played a great part in several fields of applied research, and some mention should also be made of the work in pure science. Unfortunately, it is not possible to point to great and spectacular achievements in this field, although some very sound work has been done.

Scientists Hard Pressed

In a young country the energies of its scientists must, by force of circumstances, be devoted primarily to the pressing practical problems. Consequently, the work in fundamental science has been mostly of the nature of what Sir Edward Appleton calls "objective fundamental research." Craigie's discovery of sex in the rust fungus was one major achievement in this field.

For the abstract pursuit of new knowledge to flourish, conditions are required which do not exist in most of our institutions. Nowhere in Canada will you find the peace and contemplative atmosphere of Oxford or Cambridge. We owe a debt to those who have persevered in spite of difficulties, but most scientists are too pressed with urgent problems or their duties in connection with the training of undergraduates to have the necessary leisure.

In Canada we realise the importance of a solid foundation of pure research and efforts are being made, both in the universities and in other institutions, to provide the conditions necessary for its development. As as example, I might mention the recent establishment in the National Research Council of a sub-division devoted entirely to fundamental chemistry. The members of the staff will be free to work on problems of their own choosing entirely relieved from the necessity of contributing to the solution of practical problems.

Co-operation in Research

This very hasty review of the work in the various fields of scientific endeavour has incidentally exposed the complexity of our research organisation. At the Commonwealth Scientific Conference last year, Sir Henry Tizard extolled the virtues of untidiness in the organisation of research, and the picture you have just been given would seem to give Canada an established place among the virtuous. The opportunities of overlapping and wasted effort are great, but in actual practice these vices are not serious,

because we have built up the spirit and practice of co-operation.

I wish to speak of this in some detail because it is the distinctive feature of Canadian research and has been developed to an extent which is unique. Moreover, it is through co-operation that we are able to reconcile the influence of the United States and all its reverence for regulations and organisation charts with the example from the United Kingdom of more informal and certainly unchartable organisation which exemplifies the Tizard Principle of Untidiness.

The main mechanism of co-operation is the system of associate committees established by the National Research Council in 1924, and now numbering about 40. Each of these committees deals with some major problem or with some broad field of research, and includes in its membership men from any organisation who can contribute to the work. They virtually write their own terms of reference and indeed, in some cases, no formal terms of reference exist. It is only natural, therefore, that the mode of operation should vary widely. The closest parallels in this country are the advisory councils of the various D.S.I.R. establishments.

Britain and the U.S.A.

The value of the associate committees has not by any means been confined to their immediate accomplishments. By providing employment for our younger scientists on problems of major importance, they have kept in Canada at least a small number who would otherwise have drifted to the United States. They have helped materially to break down the sense of isolation of the research men in our widely-scattered institutions. Most important of all, they have fostered that spirit of co-operation which now shows itself in so many ways in the structure and conduct of Canadian research.

With this growing spirit of co-operation within the country, it is not surprising that Canadian scientists, as a whole, look with sympathy on international co-operation. To-day I have to discuss particularly the links between Canadian and British science, but only a distorted picture could be given without referring to our relations with the United States. It is because of our proximity to that country that our ties with the United Kingdom differ in some degree from those between this country and the rest of the Commonwealth. Australia, for example, looks almost solely to England, while we in Canada must look both south and east. Many of our students receive graduate training in the United States, and unfortunately all too many of them stay in that country. A substantial proportion of our scientific people were originally citizens of the United States, and not a few Canadian scientists have risen to positions of prominence there.

In spite of the extent of our association with the U.S., there are very close bonds with science in this country, bonds which are subtly different in feeling. Canada is an American nation, but Canada is also a member of the British Commonwealth, and it is true to say that while our links with the United States are those of very friendly neighbours, our links with this country are those of members of the same family.

Continuing Migration

Historically, the first connections were established by the migration of men of scientific interests to our universities, and other institutions. This movement still continues, and has even been expanded since the end of the war. Canadian scientists have moved to England, but not as frequently as from the rest of the Commonwealth, particularly Australia.

I might, however, remind you that Lord Rutherford was on the staff of McGill University before coming to this country. In recent times a Canadian has headed the work of the Food Investigation Board. The National Research Council frequently sends members of its staff to work for a year or two in British laboratories. At present there are four men in England under this scheme.

Co-operation in actual research projects did take place on a small scale prior to the war. The war brought a great increase in co-operation of this sort. In Alberta a very large chemical warfare station was established, controlled by Canada but operated by a joint Canadian-United Kingdom staff.

The close co-operation between Canada and the United Kingdom in nuclear research, first at Montreal and then at Chalk River, is well known. In the field of radar, the United Kingdom made available to us the results of the early researches, and Canada, with this start, built a research organisation with a staff of over 700, and an associated production organisation employing up to about 10,000

I might, if there were time, mention a considerable number of other fields—naval, military, and air, as well as food production and transport—where the co-operation during the war was extremely close.

Permanent Link

To assist in maintaining the contacts necessary for this co-operation, the National Research Council established a scientific liaison office in London in 1941 and at the end of the war it was decided to put this

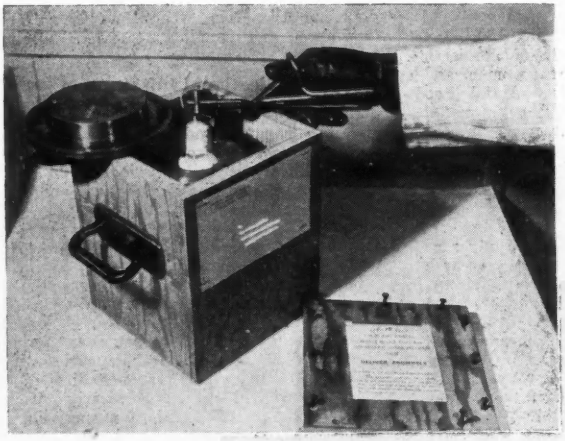
on a permanent basis. Although it is operated by the National Research Council, its facilities are freely available to all the scientific interests of the country. The intention is not the establishment of a formal official channel through which all scientific relations between the two countries must flow. Such a policy would quickly have a sterilising effect both on the office itself and the relations it is intended to foster.

We do act as a post office to transmit documents and conduct a certain amount of formal business, but we consider this side of our work to be secondary. Our main aim is to encourage to the greatest possible extent close personal relations between scientists in the two countries.

Of the measures to accomplish this, one of the most important is assistance to scientific visitors from Canada, and to scientists from this country wishing to see our work. Ensuring that these people have the opportunity to meet with their opposite numbers and to discuss with them matters of common interest is, we feel, one of our most fruitful activities.

The Commonwealth Scientific Conferences of 1946 proposed a number of measures to promote collaboration, and in all these both of our countries are taking their full share. In addition, there are the less specific links provided by membership of Canadian scientists in British scientific societies and through common membership in international organisations. Lectures, such as those given during the past year by Sir Edward Appleton and Professor Rideal in Ottawa, and by Dr. Penfield, Dr. Steacie and Dr. Best here, assist materially to increase interest in the work each of our countries is doing.

On both sides of the Atlantic there is a strong desire to strengthen the links between us. We believe that this can best be done, not by the introduction of further new mechanisms for co-operation, but by the increased use of those that already exist.



AT CHALK RIVER

Security is the keynote of the entire atomic energy research project at Chalk River, Ontario, represented here by the elaborate precautions surrounding the packing and transport of radioactive isotopes to outside research centres

The armed guard here is typical of the other aspect of the general security measures, necessitated by the failure of nations to agree to outlaw the atom bomb and share the inestimable benefits nuclear fission may offer

WORK OF THE MELLON INSTITUTE

Increasing Scale of Research for U.S. Industry

THE professional and social structure of the whole Mellon Institute group—the executive, research, and servicing staffs—is given substance by the Robert Kennedy Duncan Club, the organisation of the members that keeps alive the name and spirit of the first director. The club surrounds itself by an associative atmosphere of hospitality, generates loyalty and co-operation, contributes commendably in every way possible to cordial management-employee relations along all lines of operation.

The Club keeps open for research personnel the courses of communication through every zone from top to bottom and provides complaint and suggestion drainage, especially through its advisory council, which constantly and helpfully collaborates with the Institute's executive staff. Evident throughout the Institution is the pleasant and efficient servicing staff numbering 180.

The Institute's Department of Research in Pure Chemistry has three women and six men who rank as Fellows, and two assistants. There are five Fellows (one of them a woman) and one associate in the Department of Research in Chemical Physics. All these members are doing praiseworthy work.

Research Staff

During 1946-47 the Institute's vigorous and productive applied science research staff has consisted of 295 Fellows (advisory, administrative, senior, industrial, and junior) and their 280 aids (research associates and assistants, laboratorians, and technicians), 34 more Fellows and 16 more aids than in the preceding fiscal year. Of this personnel, 15 women have the grade of Fellow and 114 are aids.

These latter Fellows and their aids have been employed on the 80 Industrial Fellowships in operation during the year—the 30 Individual Fellowships and 50 Multiple Fellowships. Of these Fellowships, six have been proceeding 30 years or longer, others at least as follows: two, 25 years; nine, 15 years; and 19, ten years. An additional 22 Fellowships have completed five years of investigation. Releasable news regarding progress in continued Industrial Fellowship researches during 1946-47 has also been presented.

Requirements as to more personnel and more laboratory space for many continued investigational programmes have restricted in 1946-47, as in the previous year, the number of Industrial Fellowships in action. It is a managemental aim in the Institute to have all laboratories assigned and occupied so as to utilise fully all available research facilities. As has been mentioned, however, steps are being taken to provide more investigational rooms and thus to enable the inception of intermitted and new Fellowships as qualified research workers are securable. There is, of course, a reasonable limit to the size and number of Fellowships that can be administered satisfactorily.

To effect proper co-ordination, adequate supervision, and forceful concentration within the large Multiple Fellowships, they function in closely-knit groups of workers, the specific projects entrusted to them being segregated in expressly staffed and equipped sections in separate laboratories.

During the fiscal year the expenditures for pure and applied research totalled $2,697,982.

Publicational Information

During 1946, two books, 11 bulletins, 37 research papers, and 50 other scientific articles have come from the Institute. The total publications in a period of 36 years have been 24 books, 207 bulletins, and 2244 journal contributions. In 1946, 42 U.S. patents were granted to Fellows of the organisation, making the total, since 1911, 1021.

Continuing the policy of recent years, the activities of this Department (Mr. L. H. Cretcher, head) have been focused largely on synthetic organic chemistry as applied to biological and chemotherapeutic problems. Some attention has been directed to the synthesis of new anti-malarial drugs. Mr. W. W. G. Maclachlan, a specialist in internal medicine, has joined the Department as an Advisory Fellow. Mr. A. F. Bickel, a graduate of the University of Amsterdam, Holland, has worked with the departmental staff during the past year as Visiting Fellow, the holder of a Mellon Institute grant to the Netherlands Government.

New Anti-Malarial Drug

A joint publication from the Department (R. S. Tipson and Mary Clapp), the departments of chemistry of the University of Notre Dame and Columbia University, and the research laboratories of Merck & Co. describes simplified and improved pro-

cedures in the steps leading to the synthesis of ethyl quininate. The over-all yield was increased some 63 per cent. Methods of purifying the intermediates were given, and their correct melting points recorded. The work was done, in part, under contracts recommended by the Committee on Medical Research of the National Research Council in connection with the quest for new, synthetic anti-malarial drugs.

A study of the mononitrophenyl-lepidyl-carbinols has been carried further. These compounds have now been prepared in pure condition, and their hydrochlorides and acetyl and related styryl derivatives isolated. As a consequence, it is realised that much of the information in the literature regarding these substances is erroneous.

Attempts to isolate the corresponding aminophenyl carbinol derivatives have so far proved unsuccessful. While investigating the possibility of formation of the pure styryl compounds in the presence of certain inorganic acids, it was found that the *m*- and *p*-nitrobenzylidene dilepidine compounds could be prepared in good yield; but the *o*-compound could not be isolated under the same conditions (Tipson and Farley Walton).

That the 4-aminoquinolines hold promise as anti-malarial agents was vindicated by the emergence of chloroquine, 7-chloro-4-(1′ - methyl - 4′ - diethylaminobutylamino) - quinoline (SN7618), as one of the most valuable drugs studied in the anti-malarial survey conducted during World War II under the auspices of the National Research Council.

Since work in the 8-aminoquinoline series, to which pamaquine belongs, had shown that the introduction of a β-hydroxyethoxy group at position 6 lessens the toxicity, but also decreases the activity of the compounds, it was considered desirable to ascertain whether, in the 4-aminoquinolines, detoxification *without* serious diminuation of anti-malarial activity could be so obtained (thus combining to advantage the detoxifying action of the β-hydroxyethoxy group and the anti-malarial properties of 4-aminoquinolines).

A series of 6-β-hydroxyethoxy-4-aminoquinolines, in which the substituent at position 4 was widely varied, was therefore prepared. For example: (a) 6-β-hydroxyethoxy - 4 - (1′ - methyl - 4′ - diethylaminobutylamino)-quinoline contained, at the 4-position, the side-chain found in atabrine, pamaquine, and chloroquine.

(b) The 4-(3′-isopropylaminopropylamino) analogue was prepared because other investigators had shown that quinolines bearing a terminal secondary amino-group on a side-chain at the 8-position (in the 6-methoxy series) or at the 4-position (in the 7-chloro series) possess activity against avian malarial infections.

Laboratory work in progress on the kinetic aspects of alkylation by esters of sulphonic acid at the Mellon Institute

(c) 6-β-hydroxyethoxy-4-(*p*-diethylaminobenzylideneamino)-quinoline contains at position 4 the azomethine grouping also present in certain quinolines known to possess some trypanocidal and bactericidal action.

(d) Another type of substituent appeared in 6-β-hydroxyethoxy-4-(*p*-diethylaminobenzylamino)-quinoline, which contains a benzyl grouping at position 4.

Synthesis of these 6-β-hydroxyethoxy-4-aminoquinolines entailed the preparation of fairly large amounts of 6-β-hydroxyethoxy-4-chloroquinoline and 6-β-hydroxyethoxy-4-aminoquinoline (Virginia Ramsey). The preparation and characterisation of certain quinoline azomethines and their hydrogenation products, discussed last year, have been completed (Ramsey).

A number of synthetic studies of quinoline compounds have been terminated during the year and the results incorporated in reports composed for publication. A further investigation of comparative properties of 7-methylquinoline-2- and -4-mercaptans is now in progress (Alice Renfrew).

Quinine Studies

With the prospect that quinine may soon become available again as a starting material, it has been possible to resume and expand the study of specialised uses of hydroxyethylapocupreine and related derivatives in chemotherapy. Owing to its importance in the procedures of alkylation and hydroxyalkylation, involving alkyl-oxygen fission, research on the reactivity of a variety of esters of *p*-toluenesulphonic acid towards sodium iodide dissolved in acetone has been advanced.

The reactivities of the esters studied have been found to be in the same relative order as those of the corresponding organic chlorides towards the same reagent. For example, the benzyl and methyl esters are extremely reactive, and the ethyl and *n*-propyl esters somewhat less so. The activity of the ethyl ester is diminished by the introduction of a β-alkoxy group: the ethoxy, phenoxy, and benzyloxy derivatives have about the same reactivity.

The esters of the secondary alcohols are less reactive than those of the primary alcohols, and diethyl is more reactive than dimethyl carbinol. The thymyl ester, like those of certain other phenols, is devoid of activity, but its hexahydro derivative, the menthyl ester, is more reactive than bornyl and only slightly less reactive than cyclohexyl *p*-toluenesulphonate.

Iodine was liberated in the reactions with the last three esters, presumably owing to the presence of an adjacent labile hydrogen atom and resulting formation of the corresponding unsaturated hydrocarbon. The less reactive esters studied may be prepared in good yield in the presence of pyridine at room temperature.

The esters of isopropyl alcohol and thymol were obtained in crystalline condition, apparently for the first time (Tipson and Clapp).

One of these esters (benzyloxyethyl-*p*-toluenesulphonate) has long been employed in this department in the synthesis of hydroxyethylapocupreine, but the precise mechanism through which they act as alkylating agents for phenols, amines, mercaptans, and active methylene compounds has not yet been elucidated.

The effect of nuclear substituents on the rate of alkylation is under investigation, and the kinetics of the reaction of certain substituted ethyl benzenesulphonates with sodium ethoxide in ethanol has received preliminary study. It has been found to follow second-order kinetics, a discovery that strongly suggests that a bimolecular mechanism is involved.

The reaction-rate constants for three esters carrying *p*-substituents (the *p*-nitro, *p*-hydrogen, and *p*-methoxy groups) having widely different electronic influence have been carefully determined at 35°, and it has been learned that, with ethoxide ion as the nucleophilic reagent, ethyl *p*-nitrobenzenesulphonate reacts 12 times (but ethyl *p*-methoxybenzenesulphonate only 0.4 time) as rapidly as ethyl benzenesulphonate at this temperature.

It is significant that a linear relationship has been found to exist between the logarithms of these values and of the ionisation constants of the corresponding benzoic acids. If the effect of nuclear substituents so far observed holds with other nucleophilic reagents (*e.g.*, phenols), this discovery should have practical value in organic syntheses; not only should increased yields be obtainable, but alkylations of labile drugs and natural products might be carried out at lower temperatures and under milder conditions.

Benzenesulphonyl Chlorides

Some attention has also been given to the problem of synthesising certain of the substituted benzenesulphonyl chlorides which serve as precursors of the related esters; thus, the preparation of 2,4,6-trimethylbenzenesulphonyl chloride-1 and of *p*-methoxybenzenesulphonyl chloride has been studied, and various substituted ethyl benzenesulphonates have been obtained in good yield and high purity (M. S. Morgan).

The use of cyclic alkylene carbonates and sulphites for the hydroxyalkylation of phenols, amines, and mercaptans has been

extended to include the esters of a variety of 1,2- and 1,3-glycols. Alkylene sulphites have been found to react with phenols under alkaline conditions to yield hydroxyalkyl aryl ethers; in the presence of an acidic condensing agent, both alkyl-oxygen bonds are broken, and 1,2 or 1,3 di-aryloxyalkanes are formed.

Alkylene carbonates yield only hydroxyalkyl aryl ethers under either alkaline or acidic conditions of reaction. The reaction of these esters with phenols has been found to be bimolecular. In accordance with such a mechanism, the reaction with phenol of an unsymmetrical ester such as propylene carbonate proceeds by way of rupture of the primary alkyl-oxygen bond, yielding β-hydroxypropylphenyl ether.

A kinetic study of the alkaline hydrolysis of ethylene carbonate also has been made. Since only a few instances of rupture of the alkyl-oxygen bond in organic carboxylic esters have been reported, a study was made of the reaction of ethylene carbonate with reagents of varying nucleophilic activity.

If the reagent is an alkoxide or hydroxide ion, acyl-oxygen fission in ethylene carbonate occurs regardless of the solvent employed. If the reagent is a phenoxide, cyanide, or mercaptide ion, alkyl-oxygen fission of the ester bond is observed with glycol as the solvent; but acyl-oxygen fission takes place where the reactions are carried out in an aqueous medium.

With thiosulphate, xanthate, or acetate ion as the nucleophilic reagent, rupture of an alkyl-oxygen bond in ethylene carbonate has been observed even in aqueous solution.

Plant Products

Some preliminary work on certain constituents of the leaves of *Erythroxylon coca* is under way (Tipson and Clapp). In addition, a comprehensive study of the structure of the remarkable substance, leucaenine, an amino acid found in the seeds and leaves of the tropical plant *Leucaena glauca*, has been carried out. A degradation product isolated on alkaline methylation has been characterised and then successfully synthesised, leaving only two possible alternatives for the structure of leucaenine (Bickel).

In co-operation with Maud L. Menten, of Children's Hospital, Pittsburgh, testing of polysaccharide materials in relation to kidney function has been continued.

While continuing studies on the experimental diabetes induced by alloxan (in collaboration with J. A. Ruben, of Montefiore Hospital, Pittsburgh), it has come to be recognised that iron present in the solution under examination may constitute an interfering factor upon application of the "purple" test for alloxan (Tipson).

In the department of drug standardisation, K. L. Waters and R. J. Kelly are working under the direction of G. D. Beal on pharmacopoeial analytical methodology and on standards for pharmacopoeial chemicals and for pharmaceutical glassware. The principal studies relate to the chemical durability of glass containers such as ampoules. All the findings will be published.

Physical Chemistry Research

Dr. Edward R. Weidlein, director of the Mellon Institute, has announced, as the year began, the establishment there of a Department of Research in Physical Chemistry (THE CHEMICAL AGE, January 3) which, under the direction of Dr. John R. Bowman, will conduct fundamental investigations in its domain for professional and public benefit. This new department through Dr. Bowman will also aid advisorily other members of the Institute. As Dr. Bowman is a chemical engineer as well as a physical chemist, the co-operative and investigational activities of the department should be of basic value in the Institute's many programmes of research in applied science that have chemical engineering aspects.

Since its beginning, the Mellon Institute has recognised the need of fundamental scientific research as a background and source of stimulus for investigations in applied science. The Institute has therefore supported extensively disinterested investigations planned within the organisation and focused on the study of more basic problems than those usually pursued in researches in applied science or technology.

This new Department of Research in Physical Chemistry will supplement the Institute's work in pure science, carried on since 1911 and formally organised under the Department of Research in Pure Chemistry in 1926 and the Department of Research in Chemical Physics in 1946. The Department of Research in Pure Chemistry specialises in the organic, biological and pharmaceutical fields. As investigations in pure science are completed the results are published and widely disseminated.

The director of the new department has distinguished himself in applied mathematics, particularly as employed in the analysis of chemical engineering problems, and in petroleum chemistry, especially in his comprehensive original work on distillation. Born in New York, N.Y., in 1910, he was educated at the University of Pittsburgh (B.Sc., 1928; Ph.D., 1934) and at the California Institute of Technology (1929-31). Since 1935 he has been at Mellon Institute, as a Senior Fellow since 1944, on the multiple fellowship of the Gulf Research and Development Co.

Some U.S. Chemical Achievements

Innovations and Adaptations in Several Fields

A MICROCOSM of the advances made in several important branches of American chemical industry during 1947 is contained by the records of the B. F. Goodrich Chemical Company's new products during the period. Among the most noteworthy new materials and process were several new plastics materials, two oil-resistant rubbers and two other chemicals of special interest.

The first of the new products produced last year was Geon paste-forming resin, a polyvinyl chloride that is readily dispersed in plasticiser to form fluid compositions with a range of properties adaptable to the fields of dipping, coating, extruding and cast moulding.

Water-Dispersed Latex

Of equal significance was the announcement of a "ready-to-use" blend of vinyl resin and Hycar nitrile rubber called Geon polyblend. This material can be handled on either plastics or rubber machinery and eliminates the troublesome factor of plasticiser migration.

Another development announced by the company during 1947 was Geon Latex 31X, a water-dispersed material, film-forming at room temperature. This new type vinyl latex forms strong films and coatings for good adhesion to paper, fabric, leather and wood and normally contains no plasticiser. When used in conjunction with nitrile rubber latices the latex demonstrates good coagulant dip characteristics.

Special Rubbers

Apart from the new plastics materials, there were announcements in the rubber and chemical fields. Two new oil-resistant American rubbers, designated as Hycar 25-EP and Hycar 25-NS, were introduced by the chemical company and are now in commercial quantity production. Both rubbers have improved processing characteristics and are particularly adaptable to mill-blending with vinyl resins. New Hycar American rubber latices were introduced during the year and have found wide application in the paper and textile industries, where they are used in saturation, impregnation and coating applications.

Two outstanding chemicals were a new agricultural spray material called Good-rite p.e.p.s. (polyethylene polysulphide) and beta propiolactone, a new organic intermediate. Prior to introduction, the spray material underwent many months of field tests where it proved valuable as a sticker or adhesive for most of the conventional insecticides and fungicides. Good-rite p.e.p.s. also proved valuable for treating hybrid seed corn against plant killing, soil-borne organisms.

Beta propiolactone, now in semi-works production, has been compared in importance to the discovery of acetylene and chlorine. Principally, lactone is a fundamental tool in the complex science of making organic chemicals and its use makes possible for the first time in chemical history the commercial production of a whole series of organic chemicals hitherto regarded as laboratory curiosities. It will also make possible new methods of producing many of the basic chemicals now used in the plastics and chemical industries.

The 1947 expansion programme of B. F. Goodrich Chemical Company took effect in October when a new production unit was put into operation at the company's Louisville, Kentucky, plant. This unit substantially increased the output of Geon polyvinyl chloride resins and plastic compounds.

As the year came to a close, the company announced its plans for construction of a unit to produce adequate quantities of the agricultural spray chemical p.e.p.s. The unit is now being installed in the chemical company's plant at South Akron, Ohio.

New Agricultural Chemicals

At the same time, Goodrich released two more important additions in the field of agricultural and horticultural chemistry, sodium isopropyl xanthate and allyl mixed chlorophenyl carbonate. The new materials, classified as herbicides, have been tested by federal and state agricultural experiment stations and have shown excellent results against many of the weeds and grasses not economically or satisfactorily controlled by other chemicals.

Sodium isoprorpyl xanthate, a water soluble organic chemical, is a complete killer and cannot be applied directly to growing plants. It can be used, however, for pre-emergence treatment in spray or dust form for the elimination of weeds from potential planting areas.

Allyl mixed chlorophenyl carbonate, on the other hand, is a selective killer, particularly useful against certain types of grasses and similar plants. The hormone-like action of the chemical arrests growth immediately by destruction of the root and prevents seed development. Allyl mixed chlorophenyl will complement the widely accepted 2-4-D weed killer for action against some broad-leaved weeds unaffected by conventional dosage with the other product.

American Chemical Notebook

From Our New York Correspondent

THE fast-growing clad-metals industry will soon see in operation the first rolling-mill plant especially designed for the manufacture of cladmetals. The substantial investment to be represented by the mill, which is now being prepared for the American Cladmetals Company at Carnegie, Pennsylvania, in a plant 800 ft. long by 125 ft. wide, emphasises the importance of the comparatively new clad metal industry. Meanwhile, Mr. C. R. Anthony, chairman of the rolling-mill manufacturers, Pittsburgh, has announced that a growing backlog of orders for pilot lots of stainless clad copper is being accumulated by American Cladmetals. The new mill will be streamlined for simplified economical production of new and highly specialised products. Cladmetal is made up of metals bonded together in their pure state. In the rolled sheet, one of the metals, on the surfaces, clothes the other beneath. The metals are not alloyed, hence their original qualities are not changed. Stainless clad-copper is one of the many cladmetals to be produced by the company. It is the sandwiching of copper between layers of stainless steel by roll press methods. The resulting cladmetal resists contamination owing to its stainless surface, and has the added advantage of rapidly and evenly distributing heat. These two qualities in one sheet of clad metal are useful in many industrial and domestic applications where uniformity of heat distribution together with hardness and durability are much desired. The development programme of American Cladmetals also involves cladding of other metals such as aluminium to steel, and silver to steel. The company plans to produce six to eight million lb. of cladmetal annually.

* * *

The first in a series of alkylated aromatic compounds scheduled for production, diamyl phenols, used in the production of synthetic detergents, plasticisers, rubber chemicals, and modified resins, are now available from the chemical division of the Koppers Company, Inc., Pittsburgh, Pa. The diamyl phenols, as now produced, are said to be a mixture of the isomers of the diamylated phenols. The amyl substituents include both secondary amyl and tertiary amyl groups attached mainly in the 2.4-positions. This material is an oily, light straw-coloured liquid which is miscible with both aliphatic and aromatic hydrocarbons, and is essentially insoluble in water and in 10 per cent aqueous solutions of alkali hydroxides. The phenolic hydroxyl group, although insoluble in dilute aqueous alkalis, will undergo such typical reactions as acetylation. Oily condensation products are also formed by reaction with formaldehyde.

* * *

With several industrially important chemicals reaching new production peaks during the month, output of inorganic chemicals in the United States in October was greater than in September and above that of October, 1946. More phosphoric acid, chlorine gas, sodium bichromate and chromate, and activated carbon were produced in October than in any previous month on record. In the overall picture, 30 of the 35 chemicals surveyed were produced in greater quantities this October than in September, 1947, or October, 1946. The output of nitrogenous compounds in October registered sizeable gains over the previous month and alkalis, hydrochloric and sulphuric acids nearly reached record levels. Approximately 200 million more cubic feet of oxygen were produced in October, and hydrogen production increased slightly for the sixth consecutive month, and calcium carbide also increased but failed to reach the figure for October, 1946. October production of normal superphosphate fertiliser was the highest for any October on record. The month's production total of 791,625 tons was 17 per cent greater than the October, 1946, tonnage and less than 12,000 tons short of the record achieved in May, 1947. Production of concentrated superphosphate fertiliser during the same month totalled 37,944 short tons and surpassed by more than 2000 tons the previous peak of 35,875 tons.

* * *

J. R. Nicholson, executive vice-president of Polymer Corporation, Ltd., Sarnia, Ontario, Canada, has announced that his company has completed an arrangement whereby the United States Office of Rubber Reserve will take all the Canadian plant's exportable surplus of general service synthetic rubber up to March 31, 1948. The amount of rubber to be disposed of under the arrangement is expected to total 6 million lb. at 18½ cents a lb., representng about $1,100,000.

* * *

E. I. Du Pont de Nemours & Co., Inc., has signed with the State of Florida, a long-term lease on ilmenite-bearing lands, a source of future supplies of titanium pigment. The action taken by Du Pont will provide a large domestic supply of the ore and, it is thought, will end dependence upon foreign sources of supply. The lands leased by the firm are in north central Florida.

U.S. Cellophane "Monopoly"

Du Pont Co. Rejects State Charges

A NEW stage has been reached in the action under the U.S. anti-trust legislation recently filed in the District Court, Washington, D.C., charging E. I. Du Pont de Nemours & Co., Inc., with having formed, in conjunction with certain English, French and Canadian companies a monopoly of the cellophane industry. The action relates only to the U.S.A. and the foreign companies, among whom are British Cellophane, Ltd., and the Viscose Development Corporation, are, of course, not defendants.

The Department of Justice alleges that by reason of its "monopoly" the Du Pont Company has acquired and exercises control over the U.S. market for cellophane products and has excluded others from the field. This has been possible, the suit says, through cartel agreements allocating world markets between Du Pont and leading foreign makers of cellophane and providing for the exclusive interchange of technical information between the defendant company and its collaborators. The suit includes charges of "unlawful" employment of patent rights and the fixing of "arbitrary and non-competitive" prices.

Charges Rebutted

Denying the monopoly and cartel charges, the Du Pont company has issued a statement which says: "The Du Pont company not only denies the charges of violation of the anti-trust laws but is unable to figure out who stands to benefit from the Government's action. Ever since it was first produced by Du Pont in this country in 1923, cellophane has had to fight for acceptance against the competition of metal foils, waxed papers and other plastic films. By granting licences under its patents to the other American producer of cellophane, Du Pont has made it possible for its competitor to expand.

"In the course of establishing the present position of this product in the market Du Pont has greatly improved its quality, has created jobs through increased production and has made 21 price reductions from the original price of $2.65 a lb. to the current price of 42 cents a lb.

"It is true that there is not enough cellophane to-day to meet the demand. How this suit will remedy that condition is not clear for the field is open for anyone who is willing to risk the large plant investment which this business requires.

"In addition to work now in progress to increase cellophane capacity Du Pont has been planning to make further investment to expand its facilities to take care of the current demand."

"Unlimited Coal"

Powell-Duffryn's Initial Report on Queensland

AS reported in THE CHEMICAL AGE at the time, an agreement was concluded in November last between the Government of Queensland and Powell-Duffryn Technical Services, Ltd., for a complete survey of Queensland's coal resources and the drawing up of recommendations for their most efficient development.

The agreement was signed by the Hon. E. M. Hanlon, the Premier of Queensland, and Mr. Robert Foot, chairman of the company. Mr. Foot arrived in Australia at the beginning of October and spent six weeks touring all the States, in the course of which he made two visits to Queensland. In that State he inspected various coalfields and had extended discussions with the Premier, the Minister for Mines and senior Government officials.

The agreement, which will run for an initial period of 12 months as from November 1, 1947, provides for a complete assessment as to both quantity and quality of all known coal resources in Queensland with a view to their most efficient development.

This assessment will take into account: (a) The fuel requirements of the State for all industrial purposes, including electrification and gas. (b) The possible development in the State of secondary industries based on coal or its derivatives. (c) The coal resources and coal requirements of Australia as a whole. (d) Export possibilities.

Using London Laboratories

Any plan of development which is recommended will aim at ensuring the most efficient methods of coal mining and management; the best practicable conditions for the miners and other employees, and the most effective utilisation of the coal and its derivatives.

Samples will be taken of all the coals and despatched by air to England for analysis and testing in the company's central research laboratory at Battersea. As great importance is attached to the taking and packing of samples it has been decided to include a chemist in the team which will shortly be leaving for Australia to conduct the survey.

Mr. Foot said on his return to this country that he was convinced from his visit that Queensland possessed valuable coal resources, which for all practical purposes were in almost unlimited quantity. He thought that Queensland was ripe for industrial expansion which if properly organised could lead to great economic prosperity, and that the basis of this development would be coal.

Home News Items

Fire at Tar Still.—Two men were killed and three others injured when a tar still exploded and fire broke out at a tar distillery at the Old Silkstone chemical works near Barnsley, Yorks., last week. After the explosion, flames leaped to a great height and spread to oil tanks and a pitch bed. The fire was extinguished after two hours.

Coalmining Film.—"Shotfiring in Coal Mines," the colour film made by the I.C.I. Film Unit and the Technical Service Department of the Explosives Division, was shown for the first time at the British Council Theatre recently, and was enthusiastically received.

Peat Insulation.—Use of peat as an insulating material has been demonstrated by British Made Electrics, Ltd., whose heaters are now being insulated with peat fibre gathered from the Pentlands. This material is claimed to be completely successful and to enable 25 per cent less current to be used in cork-insulated types of heaters. Peat is reported to give even better results than glass wool insulation.

Import and Export Prices.—The price index number relating to total imports during November was 259 (1938 = 100), which represents a three-point increase on the October figure. The largest change occurred in raw materials, and is largely attributable to increased prices for wool. Total U.K. exports also advanced by three points, the main headings being raw materials (seven points), manufactured goods (three points), and metal goods (five points).

Bursaries and Scholarships.—The Institution of Works Managers is offering three bursaries and four scholarships tenable at the Y.M.C.A. College for Adults, Broadstairs, and Cheshunt College, Cambridge, respectively, for the best essays on a number of specially prepared industrial subjects. Further particulars are obtainable from the general secretary, Mr. T. J. Wells, and essays have to reach the Institution by February 1, 1948.

Shale Miners' Demands.—The Scottish shale oil industry is faced with a demand for a 10 per cent increase in wages on all basic rates, an advance from 16 per cent to 20 per cent on piece rates, and that Saturday shifts be paid at time and a half. The matter is now before the employers in the industry. The Union had asked that the new conditions should be brought into effect this week. A feature of recent development has been the employment of a fair number of Poles.

New Representation.—New Metals and Chemicals, Ltd., 16 Northumberland Avenue, London, W.C.2, have been appointed sole distributors for the United Kingdom for calcium metal produced by Dominion Magnesium, Ltd.

New Plastics Enterprise.—A new Nottingham enterprise producing "Perspex" articles was recently started by Mr. Dennis Raynor, a chemist and director of Textile Finishing Co., Ltd., Nottingham, and Mr. F. R. Sisson, engineer, in Commercial Street, Lenton, under the style of Clearmold Plastics.

Polish Labour and I.C.I.—I.C.I. has reached an agreement with trade unions concerned, with regard to employment of Polish labour at I.C.I. establishments. A temporary arrangement has also been made whereby the company could also employ other European volunteer workers.

Pistol Caps Warning.—Following injuries—some serious—to persons handling sheets of caps for toy pistols, the Home Office has issued a warning that irregularities in manufacture have rendered recent supplies to retailers sensitive to impact and friction. Investigations into the manufacture and distribution of these sheets are proceeding.

Fire at Cyanide Plant.—A sheet of flame from an oil tank in the cyanide plant at the L.M.S. Viaduct wagon works, Newton-le-Willows, last week caused workmen to run for their lives. The roof of the plant was destroyed, and Mr. R. E. Collins, acting superintendent of the works, said it was unlikely that the production of wagons would be interrupted.

Overseas Standards.—The Board of Trade draws attention to the benefits which manufacturers for export can obtain by consulting the British Standards Institutions' Library of Overseas Standards. The British Standards Institution, 28 Victoria Street, London, S.W.1, should also be consulted regarding drafts of standards being prepared by Commonwealth countries and regarding British Standards in the draft stage.

Fire at Chemical Works.—Flames and dense smoke that could be seen nine miles away resulted when a spectacular oil fire occurred at the works of the Mid-Durham Chemical Co. at Stella Gill, near Chester-le-Street, this week. A still containing 6000 gallons of crude oil caught fire, and the blaze spread to a nearby pitch bed. Fire-fighting units called from Chester-le-Street and Hebburn, contrived to save about 100 gallons of crude oil.

Overseas News Items

Dearer U.S. Solvents.—U.S. prices for certain petroleum-based solvents have been increased in price consequent upon the recent increase in U.S. oil prices.

Argentine Quebracho Prices.—Increases of as much as 30 per cent are expected in the price of Argentine quebracho because of demands for higher wages.

Swiss Industries Fair.—The 32nd Swiss Industries Fair will be held in Basle from April 10-20. It is expected that, as in previous years, there will be a large number of exhibitors, particularly in the big industrial sectors of metallurgy, engineering, chemicals, electricity, textiles and watches.

Zinc from Spain.—A 4000-ton cargo of zinc concentrate, said to be the first of several similar cargoes, will shortly leave Carthagena, Spain, for Swansea, it is reported. The shipment is stated to be destined for the works of the National Smelting Co. in Glamorganshire.

Industrialisation of Slovakia.—The Czechoslovak economic authorities, in pursuance of their policy to industrialise the eastern province, Slovakia, plan to erect plastics plants at Zilina and in Nováky. A wood distillation unit is to be built at Humenné and a new oil refinery in an as yet undisclosed locality.

New Brazilian Refinery.—An oil refinery is to be installed at Capuava near S. Caetano, a neighbouring town to the city of S. Paulo. The plant which will be financed with Cr$ 600 million of Brazilian capital is designed to deal with 20,000 barrels of crude oil daily; supplies will at first be imported, but it is hoped that later petroleum from the State of Bahia will be available.

India's Shellac Exports.—In November, India shipped 20,681 packages of shellac as compared with 19,368 in October. Britain absorbed 8110 (5207) packages, but shipments to the U.S. and to the Continent were somewhat lower. There was a sharp decline in shellac exports from 19,715 to 11,515 packages, chiefly because of the reduction by nearly 50 per cent of imports.

U.S. Scarce Goods Conference.—Officials of the U.S. Administration and representatives of the iron and steel industry are reported to have held a conference to allocate scarce goods for the most essential needs on a voluntary basis. It is intended subsequently to hold discussions regarding similar allocation schemes for nitrogen fertilisers, soda ash, aluminium and non-ferrous metals.

Less Soya Beans.—The 1947 world soya bean crop is estimated at 490 million bushels, *i.e.*, 4 per cent below that of 1946. The European crop is believed to be good.

Russian Fertiliser for India.—India has been promised about 15,000 tons of Russian ammonium sulphate, this quantity being in addition to the allocation from the International Emergency Food Council.

Oil Drilling in Argentina.—The Argentine State petroleum company — Tacimientos Petroliferos Fiscales — is reported to have signed a 50 million peso contract for the Drilling & Exploration Co. of Nevada to drill 40 exploratory oil wells in Argentina.

No Munitions for Middle East.—The Raufoss munition factories of Norway, Government owned, which recently accepted an order to manufacture munitions for delivery to Iraq and Persia, will not undertake this work. This decision is said to be due to a workers' resolution against the export of munitions.

Bauxite Shipping Station.—A station which is intended ultimately to enable 250,000 tons of bauxite to be shipped monthly to the U.S.A. and Canada is projected by the Alcoa Steamship Co. in Trinidad. This is to facilitate the service from the deposits in Netherlands Guiana and will provide loading capacity of 2000 tons of bauxite per hour.

Streptomycin for Madras Plague.—According to a report in the current issue of *Lancet*, the successful use of streptomycin for five cases of plague in the Madras Presidency recently, suggests that the drug may prove invaluable in new fields. Large-scale treatment of cases was prevented only by lack of supplies. No ill effects were observed in the cases treated.

French Chemical Exports.—According to official statistics, October shipments of basic chemicals from France (metric tons, September figures in parenthesis) were as follows: potassium chlorate 427 (120.4), refined soda 13,641 (23,954), pure sulphuric acid 664 (1252), copper sulphate 14.8 (98.5), ammonium sulphate 5726 (3341), and hydrogen peroxide 99.6 (26.5).

Japan's Crude Camphor.—During the first seven months of last year, Japan produced 526 metric tons of crude camphor, as compared with only 236 tons in the same period of 1946. Before the war, the bulk of Japan's requirements was imported from Formosa. There has, however, been an increasing production in Japan proper with southern Kyushu as the main centre.

PERSONAL

MR. DERRICK KLEEMANN, a director of O. & M. Kleemann, Ltd., has been appointed deputy chairman to fill the vacancy which MR. MAX KLEEMAN'S death has caused.

Prof. R. V. Southwell, F.R.S., Rector of the Imperial College of Science and Technology, who has been made a Knight in the New Year Honours

MR. H. ASHLEY MASON has been appointed overseas trade director of Evans Medical Supplies, Ltd. Other board changes announced by this company are: MR. W. A. KINNEAR is the new home sales director: MR. O. N. T. DAVENPORT has resigned.

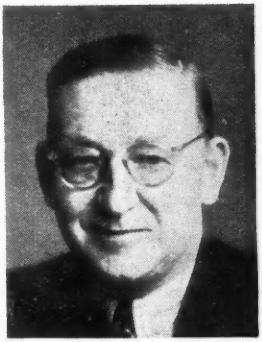
COL. L. EDGE and MR. V. A. HUGHES have been appointed directors of the Chloride Electrical Storage Co.

MR. WILLIAM HENRY ASHCROFT, of Adela Road, Runcorn, awarded the B.E.M. in the New Year Honours (Foreign Office list), is a member of the Castner Kellner works of I.C.I., Ltd., where he has been employed for 33 years.

DR. GILBERT WOODING ROBINSON, recipient of the C.B.E. in the New Year Honours, is Professor of Agricultural Chemistry at the University College of North Wales, Bangor. An authority on the chemistry of soils, he has directed soil surveys in Britain.

MR. S. A. BRAZIER, technical manager at Dunlop's factory in Cambridge Street, Manchester, received the O.B.E. in the New Year's Honours. He was chairman during the war of the technical committee of the Federation of British Rubber Manufacturers' Associations.

MR. WILLIAM DUNBAR, of St. Andrew's Road, Bebbington, has retired from Lever Bros., Port Sunlight, Ltd., after 47 years' service, part of it in Japan.



Prof. J. D. Cockroft, F.R.S., director, Atomic Energy Research Establishment, Ministry of Supply, who has been made a Knight in the New Year Honours

MR. R. I. WATSON has resigned from the board of "Shell" Transport & Trading Co., Ltd.

MISS DAISY MCDUELL, director and secretary of Triplex Safety Glass Co., Ltd., has relinquished her appointments upon reaching the firm's retiring age of 60. Miss McDuell is said to be one of the first women to hold active directorship of a public company.

The Ministry of Food announces with regret the resignation, with effect from December 31, of MR. J. W. KNIGHT, Director of the Oils and Fats Division.

Obituary

The death is announced of PROF. E. C. C. BALY, who, from 1910-37 was Grant Professor of Inorganic Chemistry at Liverpool University. He died on Saturday last at the age of 76. Educated at Temple Grove School, Aldenham, and University College, London (where he was later a member of the teaching staff) he quickly gained a reputation as an investigator. An index of his rapid advance in original investigation was the evidence which he and Dr. R. W. Riding offered at Liverpool University in 1928 in the field of atomic physics, much of which was fundamental to the present science of nuclear fission.

U.S. Export Aid

Dollar-Saving Scheme Announced

THE U.S. Department of Commerce has announced the establishment of a new export licence policy, the main purpose of which is to assist foreign buyers to save dollars. This is to be achieved by granting licences to traders not on the basis of their pre-war business, but according to the extent of their charges to foreign buyers. In effect, this will mean that the cheapest competitive exporters, *i.e.*, those who make the least demand on dollars held overseas, will receive preference.

Operative from January 2, the new policy will apply for the first three months to selected commodities now under export control, such as all chemicals and drugs (except streptomycin), all steel products, coal, coke, and some wood products.

Private traders will be favoured over foreign Government buying missions, and most export trade will be done between private U.S. exporters and private importers from abroad.

WILD-BARFIELD IN INDIA

WILD-Barfield Electric Furnaces, Ltd., announces the formation of an Indian subsidiary to be known as Indian Wild-Barfield Co., Ltd., with offices at Fort Chambers, 6-10 Dean Lane, Hammam Street, Fort, Bombay. Local management is in the hands of Mr. R. A. P. Misra, who has recently returned to India from this country where he acquired a comprehensive knowledge of the construction and uses of the company's products.

The new company will concern itself with sales and service of standard Wild-Barfield furnaces and equipment in India and Pakistan, and adjoining countries. Alfred Herbert (India), Ltd., for many years Wild-Barfield's agents, will continue to act in that capacity at its branches in Bombay, Calcutta, Kuala Lumpur, Lahore and Madras.

300,000 TONS SHORT

FIGURES issued by the Ministry of Fuel and Power show that of the 3,400,000 tons required to reach the 1947 coal target of 200 millions, 3,092,700 tons were produced last week. Although this falls short of the year's target by a little more than 300,000 tons, the Fuel Minister, Mr. H. Gaitskell, commented that it had been a great finish to the coal year, and he congratulated all concerned. In terms of percentages, the miners' effort represents a 99.8 achievement. This year's target is 214 million tons.

Next Week's Events

MONDAY, JANUARY 12

Royal Institute of Chemistry (Hull & District Section). Royal Station Hotel, Hull, 7 p.m. F. G. Tryhorn: "Forensic Science." Leeds Area Section. Chemistry Lecture Theatre, Leeds University, 6.30 p.m. E. G. Cox: "Electrostatic Hazards in Chemical Industry."

Society of Chemical Industry (Nottingham Section), and Nottingham Society of Engineers. Gas Showrooms, Nottingham, 6.30 p.m. B. Edgington: "Chemical Engineering Aspects in Handling Sterile Medical Products."

TUESDAY, JANUARY 13

Royal Institute of Chemstry (Belfast & District Section). Agriculture Lecture Theatre, Elmwood Avenue, Belfast, 7.30 p.m. A. M. Maiden: "Food and the Chemist."

Institution of Chemical Engineers. Apartments of the Geological Society, Burlington House, Piccadilly, W.1., 5.30 p.m. B. Edgington: "Chemical Engineering Aspects of Handling Sterile Medical Products."

Society of Instrument Technology. College of Technology, Manchester, 7.15 p.m. A. J. Young: "Some Impressions of Modern American Instrumentation."

Oil and Colour Chemists' Association. Lecture Room, Royal Society of Tropical Medicine and Hygiene, 26, Portland Place, W.1, 6.30 p.m. Col. L. Urwick: "Scientific Management."

WEDNESDAY, JANUARY 14

Society of Chemical Industry (Food Group). Rooms of the Medical Society of London, 11, Chandos Street, W., 2.15 p.m. P. C. T. Jones: "Decomposition of Resins by Micro-organisms in the Soil"; P. M. Webley: "Microbiological Changes in Compost"; M. J. Geoghegan: "Influence of Micro-organisms on Aggregate Formation in Soil." Plastics Group. Burlington House, Piccadilly, W.1, 6.30 p.m. E. G. K. Pritchett: "Recent Advances in the Chemistry of the Phenol-Aldehyde Condensation."

Institute of Petroleum. 26, Portland Place, W.1, 5.30 p.m. J. C. Swallow: "Polythene."

THURSDAY, JANUARY 15

Royal Institute of Chemistry (Bristol & S.W. Counties Section). Chemical Dept., University, Bristol, 5.30. G. H. Osborn: "Recent Developments in the Use of Organic Reagents in Chemical Analysis."

Society of Chemical Industry (Plastics Group). By invitation of the London section of the Plastics Institute. Waldorf Hotel, Aldwych, W.C., 6.30 p.m. Dr. Starkie: "Optical Plastics."

FRIDAY, JANUARY 16

Chelsea Polytechnic. Manresa Road, London, S.W.3. 7.30 p.m. L. Guanovszky: "The Modern Chemistry and Technology of Waxes."

Society of Chemical Industry (Glasgow Section). Royal Technical College, Glasgow, 7.15 p.m. H. Nicol: "Accidents and Lacunae in Agricultural Chemistry."

SCIENCE AND INDUSTRY

CHEMISTS from Edinburgh University and the National Coal Board were among those who collaborated in an unusual experiment worked out in Scotland in mid-December, and aimed at linking more closely the theoretical research work and knowledge of the former with practical day-to-day experience and ability of the latter. A large party of experts in various fields, drawn from Edinburgh University and the Scottish headquarters of the Board visited the Central Workshops at Cowdenbeath to give opportunity for exchange of views.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

WEST SMETHWICK METAL CO., LTD., (M., 10/1/48). December 4, charge to Barclays Bank, Ltd., securing all moneys due or to become due to the Bank; charged on Alexander Works, Oldbury Road, Smethwick. *——. March 19, 1946.

Increase of Capital

A Boake, Roberts and Company, Ltd. (52,381). Manufacturing chemists, etc., 100 Carpenters Road, Stratford, E.15. Increased by £237,500, in 200,000 5 per cent cumulative preference shares of £1 and 150,000 ordinary shares of 5s., beyond the registered capital of £300,000. All ordinary shares have now been converted into stock.

Company News

"Shell" Transport and Trading Co., Ltd., announces an ordinary interim dividend of 2½ per cent, tax free, for the year ended December 31, 1947.

O. & M. Kleeman, Ltd., has announced a net profit for the year ended August 31, 1947, of £504,587 compared with £265,061 in the previous year. Payment of a final dividend of 150 per cent has been recommended, making 270 per cent for the year, as against 80 per cent for the previous year.

New Companies Registered

Elco Plastics, Ltd. (446,803).—Private company. Capital £1000. Manufacturers of and dealers in organic and inorganic chemical substances and products; synthetic plastic and plastic substances, etc. First director: T. W. Ellis. Registered office: 5/6 Raymond Buildings, Gray's Inn, W.C.1.

Burette Laboratories, Ltd. (446,972).—Private company. Capital £3000. Objects: to acquire the business of a manufacturing chemist, etc., heretofore carried on by E. Hopkinson at 1 Caledonian Road, Leeds, as "Burette Laboratories." Directors: E. Hopkinson, C. Thompson and S. W. Thompson. Secretary: C. Thompson. Reg. office: 26 Elmwood Green, Leeds 7.

Corby Pharmacy, Ltd. (447,044).—Private company. Registered December 23. Capital £1000 in £1 shares. The directors are: John E. Beaumont, 1 Dogley Villa, Fenay Bridge, Huddersfield; Wm. C. Murray, 2 Curliss House, Corby, Lincs; and Kathleen E. Murray, 3 Curliss House, Corby (all directors of K. Ray Laboratories, Ltd.). Solicitors: Andrews Stanton & Ringrose, Bourne. Reg. office: High Street, Corby, Lincs.

Geigy-Hardisty Co., Ltd. (446,986).—Private company. Capital £50,000. Objects: Manufacturing and selling sebacic acid, capryl alcohol and related products and chemical combinations of such products with one or more other chemicals, etc. Directors: C. F. Gysin, H. Jones, C. S. Messinger and J. Stead. Secretary: H. Worthington. Reg. office: National Buildings, Parsonage, Manchester.

A. Widdison, Ltd. (447,025).—Private company. Registered December 23. Capital £1600 in £1 shares. Objects: to carry on the business of wholesale and retail chemists and druggists, etc. The subscribers (each with one share) are: Arthur Widdison, M.P.S., 85 Haverstock Hill, N.W.3; and John T. Headley, 25 Abbey Road, St. John's Wood, N.W.8, audit clerk. Secretary: A. Widdison. Reg. office: 85 Haverstock Hill, N.W.3. The first directors are not named.

Foreland Trading Co., Ltd. (447,055).—Private company. Registered December 23. Capital £1500 in £1 shares. Objects: to carry on the business of manufacturers and distributors of and dealers in domestic cleansers, abrasives, chemicals, gases, drugs, etc. The directors are: Ernest A. C. Adams, "Forelands," Shooters Hill, Woolwich, S.E.18 (director of Kalim, Ltd.), and Harry R. Adams, 63 Bradstow Way, Broadstairs. Reg. office: Alpha Works, Alpha Street, Peckham, S.E.15.

Coates & Cooper, Ltd. (447,043).—Private company. Registered December 23. Capital £10,000 in £1 shares. Objects: to carry on the business of importers, manufacturers, exporters and distributors of medical and pharmaceutical products carried on by a company of the same name (now in voluntary liquidation). The directors are: Richard R. Coates (chairman and governing director), "Arncote," Juniper Hill, Rickmansworth; Mrs. Dorothy M. Coates, same address; Geo. A. Coates, M.P.S., same address; and Chas. G. Reid, F.C.A., 60a, Shepherds Hill, Highgate, N.6. Solicitors: Kennedy, Ponsonby and Prideaux, 52 Bishopsgate, E.C.2. Reg. office: 62 London Wall, E.C.2.

North Eastern Science Supplies, Ltd. (446,894).—Private company. Capital £10,000. Manufacturers of and dealers in chemicals, drugs, gases, medicines; manufacturers, testers and repairers of scientific instruments, compasses, barometers, etc. Subscribers: A. S. Bean and J. Brown. Manager: J. Brown. Reg. office: 66 John Street, Sunderland.

Chemical and Allied Stocks and Shares

FOLLOWING the burst of activity which accompanied initial dealings in British Transport stock, stock markets quietened down with gilt-edged steady, but industrials reflected profit-taking and lost part of their recent big gains. Nevertheless, numerous shares of chemical and allied companies were better on balance for the week. It is realised that unless substantial progress is made in export markets, the next Budget will be very unpleasant in many respects, and measures will have to be taken to deal with the inflation menace. On the other hand, it is being pointed out that so far as the stock and share markets are concerned, transport and other nationalisation measures mean a substantial reduction in the range of investment securities available, and the weight of money seeking investment may very well force up prices. Another point of importance from the stock market viewpoint is that in 1948 many companies will publish consolidated accounts for the first time, which must provide a good deal of additional information.

Imperial Chemical after a further sharp rise at the end of last week, came back to 50s. 9d. in accordance with the general trend of markets. There was little selling, but buying was moderate compared with that recently in evidence. B. Laporte were 88s. 9d., and W. J. Bush 87s. 6d. Monsanto Chemicals 5s. ordinary eased to 64s. 4½d., but in other directions on hopes of a higher interim dividend, British Glues & Chemicals 4s. ordinary rose further to 24s. 4½d. British Aluminium have been firm at 53s. 9d. on higher dividend talk, while Borax Consolidated deferred were 56s. 3d. On the other hand, following their recent advance, Turner & Newall have eased to 88s. 9d., United Molasses were 55s. British Plaster Board 26s. 7½d., and the units of the Distillers Co. came back to 30s. 7½d. Glaxo have eased to £22½, British Drug Houses 5s. shares changed hands around, 12s. 3d., and at the time of writing Lever & Unilever have come back to 53s. 10½d. Dunlop Rubber were 77s. 6d.

Iron and Steels were inclined to ease with the general trend, although in view of the good yields, buyers appeared, leaving prices only moderately lower on balance, United Steel were 28s. 3d. Dorman Long 29s. 9d., Guest Keen 49s. 6d., and Stewarts and Lloyds 58s. 4½d. Allied Iron were 64s. and Babcock & Wilcox 74s. 6d., while in anticipation of the results due next month, Clarke Chapman were 58s. 9d. Imperial Smelting shares have firmed up to 22s. 9d. Although the Bill for nationalisation of the industry is expected shortly after the reassembly of Parliament, stocks and shares of gas companies are continuing to strengthen, buyers coming on the assumption that a fair compensation must be above current market values, bearing in mind all factors in the position and the fact that assets of many gas companies are believed to be very conservatively valued in their accounts. Gas Light & Coke ordinary have further strengthened to 23s. 3d. and South Metropolitan stock to 99.

Courtaulds after an earlier rise, eased to 44s. 6d., and British Celanese were 24s. 9d. Shares of companies connected with plastics remained rather more active, with British Xylonite £8½ and British Industrial Plastics 2s. shares 9s. 6d. In other directions, Boots Drug came back to 62s. 3d., Beechams dedeferred to 23s. 9d., and Sangers to 35s. 3d. Oils remained active with Shell 76s. 10½d., and the new shares 16s. 3d. premium Anglo-Iranian have firmed up to £8 13/16 and Burmah Oil to 75s. C. C. Wakefield were 78s. 9d., awaiting the full terms of the company's forthcoming big issue of preference shares.

Latest Oil Prices

LONDON.—January 9. For the period ending January 31 (Feb. 28, 1948, for refined oils), per ton, naked, ex mill, works or refinery, and subject to additional charges according to package; LINSEED OIL, crude, £200. RAPESEED OIL, crude, £190. COTTONSEED OIL, crude, £109; washed, £112. COCONUT OIL, crude, £106; refined deodorised, £112; refined hardened deodorised, £116. PALM KERNEL OIL, crude, £105 10s., refined deodorised, £112; refined hardened deodorised, £116. PALM OIL (per ton c.i.f.), in returnable casks, £99 5s.; in drums on loan, £98 15s., in bulk, £97 15s. GROUNDNUT OIL, crude, £110 10s.; refined deodorised, £114, refined hardened deodorised, £118. WHALE OIL, refined hardened, 42 deg., £117; refined hardened, 46/48 deg., £118. ACID OILS, Groundnut, £94; soya, £92; coconut and palm-kernel, £97 10s. ROSIN: Wood, 40s. 6d. to 48s.; gum, 56s. to 62s. 6d. per cwt., ex store, according to grade. TURPENTINE, American, 87s. per cwt. in drums or barrels, as imported (controlled price).

Prices of British Chemical Products

THERE has been no special developments during the week, buying in most sections has been steady and negotiations for forward contracts have occupied a good deal of attention. A substantial export inquiry is in circulation and a more hopeful prospect of meeting overseas demands is beginning to show itself as a result of improvements in home production. An advance of £2 10s. per ton in the price of dry white lead and an advance of £2 per ton on ground white lead has been notified by the makers. Red lead has also been increased by £1 10s. per ton, while sodium bisulphite has been increased from £19 10s. to £28 7s. 6d. per ton. The concessions made by the United Kingdom under the Geneva Tariff Agreement cover relatively few chemical products. A number of items are bound at the existing rate and for others a ceiling has been fixed beyond which additional duty will not be imposed. Of special note is the reduction of the rate of duty on citric acid, tartaric acid and cream of tartar, all of which are now chargeable with only the general *ad valorem* duty of 10 per cent in place of the former rate of 20 per cent. Potassium nitrate is now free of duty. Owing to the general supply position it is not expected that any noticeable increase in the imports of these items will result in the immediate future. A steady demand is maintained for most of the coal-tar products and the export trade in pitch has been good.

MANCHESTER.—A strong undertone on the chemical market has been reflected in advances in prices in a number of directions during the past week, and after the recent holiday slackness, activity has been more in evidence on the Manchester market. Bleaching, dyeing and finishing chemicals have been in steady demand and contracts for these and for other leading industrial chemicals has been drawn against in good quantities.

Price Changes

Rises: Barium carbonate, barium chloride, barium sulphate (dry blanc fixe), formaldehyde, hydrogen peroxide, lead (white and red), oxalic acid, sodium bicarbonate, sodium sulphide, sodium bisulphite, ammonium sulphate, and "nitro-chalk."

General Chemicals

Acetic Acid.—Maximum prices per ton: 80% technical, 1 ton, £56 10s.; 80% pure, 1 ton, £58 10s.; commercial glacial 1 ton £70; delivered buyers' premises in returnable barrels: £4 10s. per ton extra if packed and delivered in glass.

Acetone.—Maximum prices per ton, 1/5 tons, £86 10s.; single drums, £87 10s.; delivered buyers' premises in returnable drums or other containers having a capacity of not less than 45 gallons each. For delivery in non-returnable containers of 40/50 gallons, the maximum prices are £3 per ton higher. Deliveries of less than 10 gallons free from price control.

Alum.—Loose lump, £16 per ton, f.o.r. MANCHESTER: £16 10s.

Aluminium Sulphate.—Ex works, £11 10s. per ton d/d. MANCHESTER: £11 10s.

Ammonia, Anhydrous.—1s. 9d. to 2s. 3d. per lb.

Ammonium Bicarbonate. — MANCHESTER: £41 per ton d/d.

Ammonium Carbonate.—£42 per ton d/d in 5-cwt. casks. MANCHESTER: Powder, £43 d/d.

Ammonium Chloride. — Grey galvanising, £22 10s. per ton, in casks, ex wharf. Fine white 98%, £21 to £25 per ton. See also Salammoniac.

Ammonium Persulphate.—MANCHESTER: £5 per cwt. d/d.

Antimony Oxide.—£162 10s. per ton.

Arsenic.—Per ton, £40 5s. to £41 5s., according to quality, ex store.

Barium Carbonate.—Precip., d/d; 2-ton lots, £25 15s. per ton, bag packing, ex works.

Barium Chloride.—98/100% prime white crystals, 5-ton lots, £26 per ton, bag packing, ex works.

Barium Sulphate (Dry Blanc Fixe).—Precip., 4-ton lots, £26 10s. per ton d/d; 2-ton lots, £26 15s. per ton.

Bleaching Powder.—Spot, 35/37%, £11 to £11 10s. per ton in casks, special terms for contract.

Borax.—Per ton for ton lots, in free 1-cwt. bags, carriage paid: Commercial, granulated, £30; crystals, £31; powdered, £31 10s.; extra fine powder, £32 10s. B.P., crystals, £39; powdered, £39 10s.; extra fine, £40 10s. Borax glass, per ton in free 1-cwt. waterproof paper-lined bags, for home trade only, carriage paid: lump, £77; powdered, £78.

Boric Acid.—Per ton for ton lots in free 1-cwt. bags, carriage paid: Commercial, granulated, £52; crystals, £53; powdered, £54; extra fine powder, £56. B.P., crystals, £61; powder, £62; extra fine, £64.

Calcium Bisulphide.—£6 10s. to £7 10s. per ton f.o.r. London.

Calcium Chloride.—70/72% solid, £5 15s. per ton, ex store.

Charcoal, Lump.—£25 per ton, ex wharf. Granulated, £30 per ton.

Chlorine, Liquid.—£23 per ton, d/d in 16/17-cwt. drums (3-drum lots).

Chrometan.—Crystals, 5⅝d. per lb.

Chromic Acid.—1s. 10d. to 1s. 11d. per lb., less 2½%, d/d U.K.

Citric Acid.—Controlled prices per lb., d/d buyers' premises. For 5 cwt. or over, anhydrous, 1s. 6¾d., other, 1s. 5.; 1 to 5 cwt., anhydrous, 1s. 9d., other, 1s. 7d. Higher prices for smaller quantities.

Copper Carbonate.—MANCHESTER: 1s. 8d. per lb.

Copper Oxide. — Black, powdered, about 1s. 4½d. per lb.

Copper Sulphate.—£42 10s. per ton f.o.b., less 2%, in 2-cwt. bags.

Cream of Tarter.—100%, per cwt., from 201s. to 205s. per cwt. lots, d/d.

Formaldehyde.—£28 to £29 per ton in casks, according to quantity, d/d. MANCHESTER: £30 10s.

Formic Acid.—85%, £55 per ton for ton lots, carriage paid.

Glycerine.—Chemically pure, double distilled 1260 s.g., 123/1 per cwt. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hexamine.—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 1d. to 2s. 3d. per lb.; carriage paid for bulk lots.

Hydrochloric Acid.—Spot, 7s. 6d. to 8s. 9d. per carboy d/d, according to purity, strength and locality.

Hydrofluoric Acid.—59/60%, about 1s. to 1s. 2d. per lb.

Hydrogen Peroxide.—10½d. per lb. d/d, carboys extra and returnable.

Iodine.—Resublimed B.P., 10s. 4d. to 14s. 6d. per lb., according to quantity.

Lactic Acid.—Pale tech., £70 per ton; dark tech., £60 per ton ex works; barrels returnable.

Lead Acetate.—White, 110s. to 115s. per cwt., according to quantity.

Lead Nitrate.—About £115 per ton d/d in casks. MANCHESTER: £115.

Lead, Red.—Basic prices per ton: Genuine dry red lead, £106; orange lead, £118. Ground in oil: Red, £152; orange, £144. Ready-mixed lead paint: Red, £140; orange, £152 (subject to increase of £1 10s. per ton).

Lead, White.—Dry English, in 8-cwt. casks, £119 per ton. Ground in oil, English, in 5-cwt. casks, £143 per ton.

Litharge.—£103 10s. to £106 per ton.

Lithium Carbonate.—7s. 9d. per lb. net.

Magnesite.—Calcined, in bags, ex works, £18 5s.

Magnesium Chloride.—Solid (ex wharf), £27 10s. per ton.

Magnesium Sulphate.—£12 to £14 per ton.

Mercuric Chloride.—Per lb., for 2-cwt. lots, 7s. 6d.; smaller quantities dearer.

Mercurous Chloride.—8s. 10d. to 9s. per lb., according to quantity.

Mercury Sulphide, Red.—Per lb., from 10s. 3d. for ton lots and over to 10s. 7d. for lots of 7 to under 30 lb.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 4s. 4d. per gal.; pyridinised 64° O.P. 100 gals., 4s. 5d. per gal.

Nitric Acid.—£24 to £26 per ton, ex works.

Oxalic Acid.—£110 to £121 per ton packed in free 5-cwt. casks. MANCHESTER: £5 10s. per cwt.

Paraffin Wax.—Nominal.

Phosphorus.—Red, 3s. per lb. d/d; yellow, 1s. 10d. per lb. d/d.

Potash, Caustic.—Solid, £65 10s. per ton for 1-ton lots; flake, £76 per ton for 1-ton lots. Liquid, d/d, nominal.

Potassium Bichromate. — Crystals and granular, 9⅝d. per lb.; ground, 10⅝d. per lb., for not less than 6 cwt.; 1-cwt. lots, ¼d. per lb. extra.

Potassium Carbonate.—Calcined, 98/100%, £64 per ton for 1-ton lots, ex store; hydrated, £58 for 1-ton lots.

Potassium Chlorate.—Imported powder and crystals, nominal.

Potassium Iodide.—B.P., 8s. 8d. to 12s. per lb., according to quantity.

Potassium Nitrate.—Small granular crystals, 76s. per cwt. ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 8½d. per lb. for 1-cwt. lots; for 3 cwt. and upwards, 1s. 8d. per lb.; technical, £7 14s. 3d. to £8 6s. 3d. per cwt., according to quantity d/d.

Potassium Prussiate.—Yellow, nominal.

Salammoniac.—First lump, spot, £48 per ton; dog-tooth crystals, £50 per ton; medium, £48 10s. per ton; fine white crystals, £21 to £25 per ton, in casks, ex store.

Salicylic Acid.—MANCHESTER: 2s. 2d. to 3s. per lb. d/d.

Soda, Caustic. — Solid 76/77%; spot, £18 4s. per ton d/d.

Sodium Acetate.—£42 per ton, ex wharf.

Sodium Bicarbonate.—Refined, spot, £11 per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 8d. per lb.; anhydrous, 7½d. per lb., net, d/d U.K. in 7-8 cwt. casks.

Sodium Bisulphite. — Powder, 60/62%, £28 7s. 6d. per ton d/d in 2 ton lots for home trade.

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Sodium Iodide.—B.P., for not less than 28 lb., 10s. 2d. per lb.
Sodium Metaphosphate (Calgon).—11d. per lb. d/d.
Sodium Metasilicate.—£18 per ton, d/d U.K. in ton lots.
Sodium Nitrite.—£22 10s. per ton.
Sodium Percarbonate.—12½% available oxygen, £7 11s. 9d. per cwt. in 1-cwt. drums.
Sodium Phosphate.—Di-sodium, £30 10s. per ton d/d for ton lots. Tri-sodium, £35 per ton d/d for ton lots (crystalline).
Sodium Prussiate.—9d. to 9½d. per lb. ex store.
Sodium Silicate.—£6 to £11 per ton.
Sodium Sulphate (Glauber Salt).—£8 per ton d/d.
Sodium Sulphate (Salt Cake).—Unground. Spot £4 11s. per ton d/d station in bulk. MANCHESTER: £4 15s. per ton d/d station.
Sodium Sulphide. — Solid, 60/62%, spot, £23 per ton, d/d, in drums; broken, £23 15s. per ton, d/d, in casks.
Sodium Sulphite.—Anhydrous, £29 10s. per ton; pea crystals, £20 10s. per ton d/d station in kegs; commercial, £12 to £14 per ton d/d station in bags.
Sulphur.—Per ton for 4 tons or more, ground, £14 12s. 6d. to £16 17s. 6d., according to fineness.
Sulphuric Acid.—168° Tw., £6 2s. 8d. to £7 2s. 8d. per ton; 140° Tw., arsenic-free, £4 15s. per ton; 140° Tw., arsenious, £4 7s. 6d. per ton. Quotations naked at sellers' works.
Tartaric Acid.—Per cwt., for 10 cwt. or more, £15 8s.; 5 to 10 cwt., £15 9s. 6d.; 2 to 5 cwt., £15 11s.; 1 to 2 cwt., £15 13s. Less than 1 cwt., 3s. 1d. to 3s. 3d. per lb. d/d, according to quantity.
Tin Oxide.—1-cwt. lots d/d £25 10s.
Zinc Oxide.—Maximum price: per ton for 2-ton lots, d/d; white seal, £68 15s.; green seal, £70 5s.; red seal, £71 5s.
Zinc Sulphate.—No quotation.

Rubber Chemicals

Antimony Sulphide.—Golden, 3s. to 4s. per lb. Crimson, 2s. 7½d. to 3s. per lb.
Arsenic Sulphide.—Yellow, 1s. 9d. per lb.
Barytes.—Best white bleached, £8 3s. 6d. per ton.
Cadmium Sulphide.—6s. to 6s. 6d. per lb.
Carbon Bisulphide.—£37 to £41 per ton, according to quality, in free returnable drums.
Carbon Black.—6d. to 8d. per lb., according to packing.
Carbon Tetrachloride.—£50 10s. to £53 10s. per ton, according to quantity.
Chromium Oxide.—Green, 2s. per lb.
India-rubber Substitutes.—White, 10 5/16d. to 1s. 5¾d. per lb.; dark, 10½d. to 1s. per lb.
Lithopone.—30%, £32 17s. 6d. per ton.
Mineral Black.—£7 10s. to £10 per ton.
Mineral Rubber, "Rupron."—£20 per ton.
Sulphur Chloride.—7d. per lb.
Vegetable Lamp Black.—£49 per ton.
Vermilion.—Pale or deep, 15s. 6d per lb. for 7-lb. lots.

Nitrogen Fertilisers

Ammonium Phosphate.—Not quoted—temporarily unobtainable.
Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station, in January, £10 5s., rising by 1s. 6d. per ton per month to March, 1948.
Calcium Cyanamide.—Nominal; supplies very scanty.
Concentrated Fertilisers. — Per ton d/d farmer's nearest station, I.C.I. No. 1 grade, where available, £14 18s. 6d.
"Nitro-Chalk."—£10 4s. per ton in 6-ton lots, d/d farmer's nearest station.
Sodium Nitrate.—Chilean super-refined for 6-ton lots d/d nearest station, £17 5s. per ton; granulated, over 98%, £16 per ton.

Coal-Tar Products

Benzol.—Per gal. ex works: 90's, 2s. 6d.; pure, 2s. 8¼d.; nitration grade, 2s. 10½d.
Carbolic Acid. — Crystals, 11½d. per lb. Crude, 60's, 3s. 6d. to 4s. MANCHESTER: Crystals, 9½d. to 11½d. per lb., d/d; crude, 4s. 3d., naked, at works.
Creosote.—Home trade, 6¼d. to 9¾d. per gal., according to quality, f.o.r. maker's works. MANCHESTER: 6¼d. to 9¾d. per gal.
Cresylic Acid.—Pale, 97%, 3s. 6d. per gal.; 99%, 4s. 2d.; 99.5/100%, 4s. 4d. American, duty free, 4s. 2d., naked at works. MANCHESTER: Pale, 99/100%, 4s. 4d. per gal.
Naphtha.—Solvent, 90/160°, 2s. 10d. per gal. for 1000-gal. lots; heavy, 90/190°, 2s. 4d. per gal. for 1000-gal. lots, d/d. Drums extra; higher prices for smaller lots. Controlled prices.
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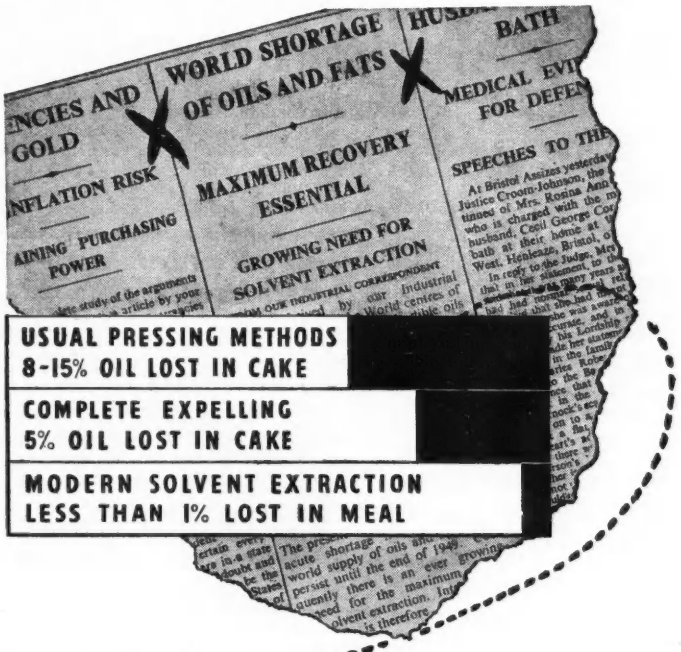

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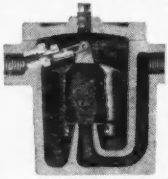

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